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ABSTRACT

A survey was initiated at the request of the U.S. Office of Education and the Energy Task Force to: (1) measure the increase in energy expenditures since the OPEC oil embargo of 1973-74; (2) assess changes in energy consumption over a two-year period; and (3) examine some of the specific conservation practices of higher education institutions. Each college respondent was asked to indicate, for each of the two survey years: (1) the amount of each type of fuel consumed and the total cost; (2) the institution's involvement in three stages of energy conservation; and (3) selected institutional experiences during the period of the oil embargo. Respondents were asked to report only the amounts of fuel used to maintain buildings and facilities, and to exclude transportation fuel needs. The results are presented in detailed statistical tables and analyzed in the aggregate. (Author/MSE)

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Energy Costs and Energy Conservation Programs in Colleges and Universities: 1972-73 and 1974-75

ED142135

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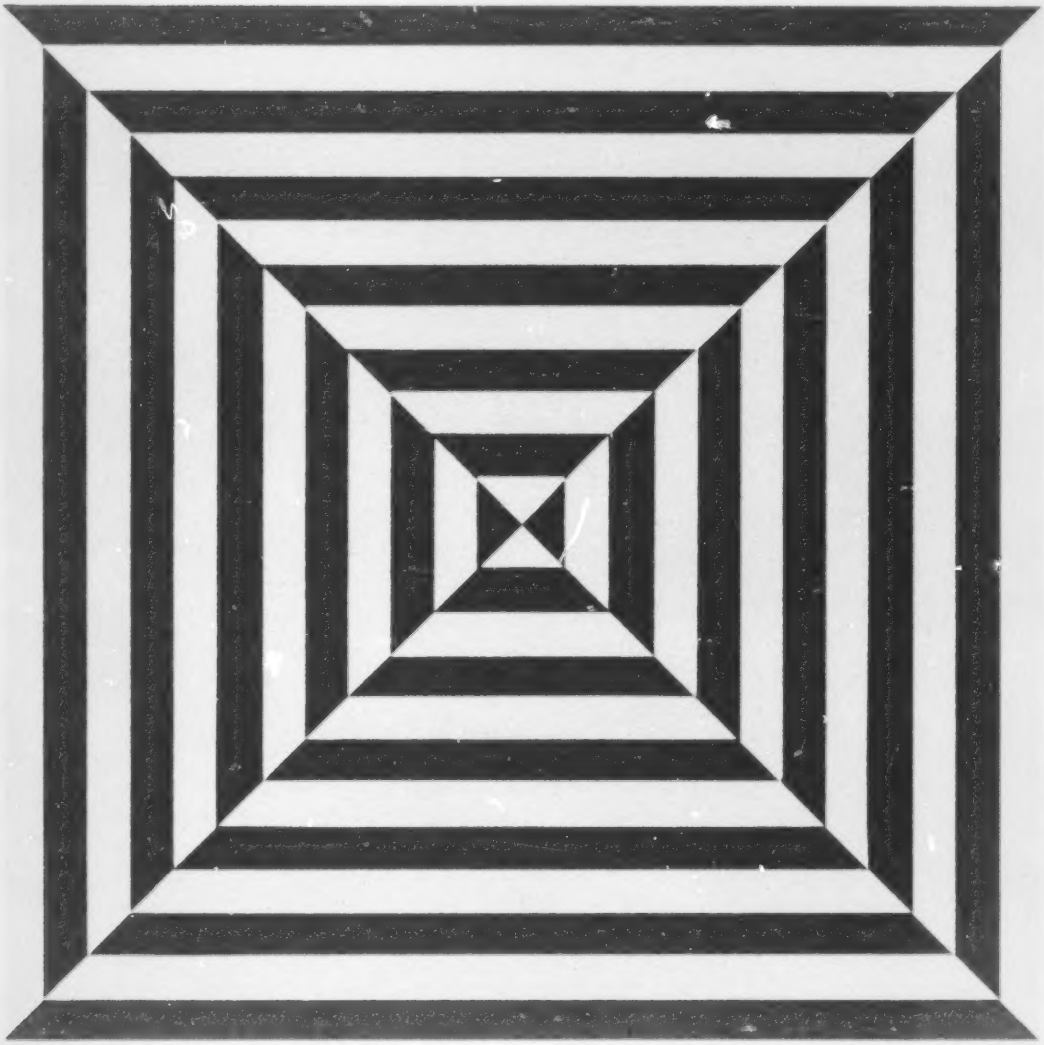

HIGHER EDUCATION PANEL REPORTS, NUMBER 31
AMERICAN COUNCIL ON EDUCATION

APRIL
1977

A Survey Funded by the National Science Foundation, the Office of Education, the National Institutes of Health, and the Energy Task Force

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AMERICAN COUNCIL ON EDUCATION

Roger W. Heyns, *President*

The American Council on Education, founded in 1918, is a council of educational organizations and institutions. Its purpose is to advance education and educational methods through comprehensive voluntary and cooperative action on the part of American educational associations, organizations, and institutions.

The Higher Education Panel is a survey research program established by the Council for the purpose of securing policy-related information quickly from representative samples of colleges and universities. *Higher Education Panel Reports* are designed to expedite communication of the Panel's survey findings to policy-makers in government, in the associations, and in educational institutions across the nation.

The Higher Education Panel's surveys on behalf of the Federal Government are conducted under grant support provided jointly by the National Science Foundation, the National Institutes of Health, and the U. S. Office of Education (NSF Grant SRS-7617080).

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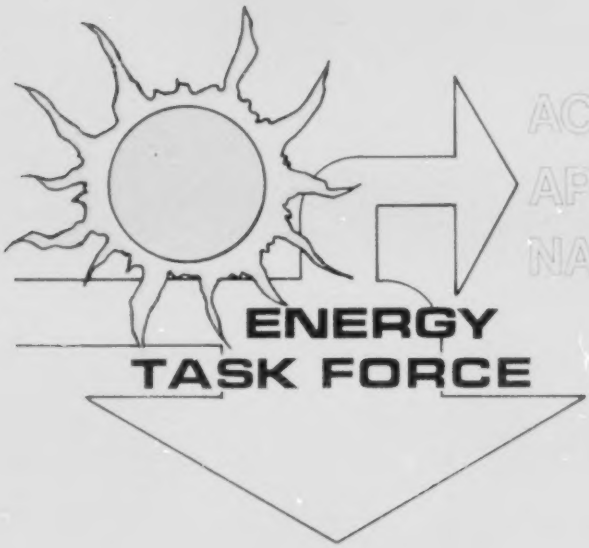
Higher Education Panel surveys typically involve the ideas and efforts of many persons and organizations, and this involvement was perhaps more true of the present survey than of any in the past. In particular, we wish to acknowledge the close cooperation of David I. Newton, Executive Director of the Energy Task Force, and Richard T. Sonnergren, Special Assistant to the Deputy Commissioner for Postsecondary Education at the U.S. Office of Education. The help of both, acting as liaisons with the sponsoring organizations, was always constructive and often indispensable. The survey also benefited from the interest and ideas of John Baird, formerly with the Federal Energy Administration; John F. Embersits, Chairman of the Energy Task Force; and Jerold W. Jones, Associate Professor of Engineering at the University of Texas at Austin, and Joseph Steinberg of Survey Design, Inc., who served as consultants about the energy measures and statistical techniques used in presenting the survey data. The suggestions offered by members of the HEP advisory groups (whose members are listed on the inside cover of this report) were also valuable.

Computer programming and related services were provided by Nabil Issa. Laura Kent edited the manuscript, and Elaine Chamberlain typed the drafts of the final report.

As always, our special thanks go to the Panel institutions for their support. As a first-time effort in developing data about energy, this survey depended heavily on the cooperation of our Panel representatives on campus and the presidents of the surveyed institutions, as well as the business officers and the physical plant administrators who were our prime resources for the data. We are grateful to them all and hope that the results will prove their efforts worthwhile.

This survey was sponsored jointly by the U.S. Office of Education and the Energy Task Force, a group organized by the American Council on Education, the Association of Physical Plant Administrators, and the National Association of College and University Business Officers.



ACE
APPA
NACUBO

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Highlights

National Estimates

- Between the 1972-73 academic year (which is FY 1973) and the 1974-75 academic year (FY 1975), total energy costs at colleges and universities rose from $555 million to $944 million, a 70 percent increase.
- Over the same period, total energy consumption decreased by 6 percent from 4.25 billion therms to 4.01 billion therms. Adjusted for changes in the number of square feet serviced, the decrease was about 12 percent.
- Overall energy costs averaged 13.1 cents per therm in 1972-73 and 23.5 cents per therm in 1974-75, a 79 percent increase.
- The greatest increase in per-unit cost during the survey period occurred for oil (163 percent), followed by coal (126 percent). The per-unit cost of natural gas and purchased electricity increased less drastically (64 percent and 57 percent, respectively).
- In both years, natural gas provided 45 percent of total therms consumed; electricity and oil each provided about 20 percent; and coal, slightly more than 10 percent. The relative consumption of both oil and coal decreased slightly over the period.
- Electricity accounted for 55 cents of each energy dollar spent by higher education in 1974-75; oil and natural gas, about 18 cents each; and coal, 6 cents.

Regional Estimates

- Institutions in the East and South experienced the greatest increases in total energy costs—94 percent and 84 percent, respectively. Smaller increases occurred in the Midwest (48 percent) and the West (40 percent).
- The per-unit cost of energy increased most at institutions in the East (101 percent), from 16.5 cents to 33.2 cents per therm. The South averaged a 97 percent increase (from 11.6 cents to 22.9 cents); the Midwest, 58 percent (from 12.4 cents to 19.6 cents); and the West, 50 percent (from 11.6 cents to 17.5 cents).
- Over the two-year period, the per-unit cost of both natural gas and coal rose most sharply in the South (100 percent and 185 percent, respectively).
- Oil was the predominant source of energy in the East (providing nearly 50 percent of the total therms consumed), whereas natural gas was the predominant source in the West (providing about 65 percent of total therms consumed), in the South (over 50 percent), and in the Midwest (just under 50 percent).

Cost Per Student

- Nationally, the energy costs per student increased 57 percent between 1972-73 and 1974-75, from $79 to $124.
- The East experienced the greatest per-student increase in energy costs: from $103 to $184, a 78 percent rise.
- The smallest increases occurred in the West, where energy costs were lowest: from $57 per student in 1972-73, to $71 in 1974-75, a 25 percent increase.

Cost Per Square Foot

- The energy cost per square foot of institutional space serviced increased 57 percent from 1972-73 to 1974-75, from 27.6 cents to 43.4 cents.
- The largest increase occurred in the East: from 31.8 cents per square foot in the earlier year to 57.6 cents per square foot in the later year, an 81 percent increase.
- Institutions in the West experienced the lowest increase: from 24.3 cents to 31.5 cents per square foot, a 30 percent increase.

Consumption Per Square Foot

- Nationally, total energy consumption dropped over the period from 2.11 therms per square foot to 1.85 therms, a 12 percent decline. (These figures represent adjustment for changes in the amount of space serviced.)
- Institutions in the East reported a 9 percent reduction in energy consumption per square foot; figures reported by institutions in the other three regions more closely resembled the national figure.

Proportion of Current Fund Expenditures (CFE)

- The median percentage of CFE that went for energy rose from 2.7 percent in 1972-73 to 3.6 percent in 1974-75.
- Institutions in the East spent the largest proportions

of CFE for energy (3.1 percent in the earlier year and 4.4 percent in the later year), and those in the West spent the smallest proportions (2.2 percent in the earlier year and 2.1 percent in the later year).

Reliance on Specific Types of Fuel

- Institutions dependent primarily on oil reported an 82 percent increase in total energy costs (from $132 to $239 million); those dependent primarily on coal, a 79 percent increase (from $51 to $92 million); and those dependent on natural gas, a 46 percent increase (from $267 to $389 million).
- Colleges and universities relying chiefly on oil experienced a 116 percent increase in their per-unit cost of energy, from 15.3 cents to 33 cents per therm.
- Institutions relying chiefly on either natural gas or coal experienced per-unit cost increases of 62 percent and 86 percent, respectively, bringing their total energy cost up to 19 cents per therm for each type of fuel.
- In 1974-75, oil-dependent institutions spent $194 per student for energy, those relying primarily on coal paid $151 per student, and those relying on natural gas paid $108 per student.

Type of Institution

- The increase in per-unit cost of energy was about the same—80 percent—at each of the three institutional types: doctoral-granting institutions and other comprehensive universities and colleges; other four-year colleges; and two-year colleges.
- In 1974-75, on average, doctoral and comprehensive institutions paid 21.5 cents per therm, other four-year colleges averaged 23.9 cents per therm, and two-year colleges paid 30.4 cents per therm.
- Two-year colleges reduced their total energy consumption by 15 percent; doctoral and comprehensive institutions, by 5 percent; and other four-year colleges, by 3 percent.
- When adjustments are made for space changes during the survey period, the reduction in energy consumed turns out to be greater: 26 percent at two-year institutions, and about 10 percent each at the two other categories of institutions.
- On a per-student basis, differences in the amounts of energy used varied widely among the three institutional types. In 1974-75, the energy used per student averaged about 750 therms at doctoral and comprehensive institutions, 570 therms at other four-year institutions, and about 200 therms at the two-year colleges.

Conservation Measures

- Three phases of conservation effort were defined: *quick fix*, involving obvious measures that achieve significant energy savings at small cost; *refit*, involving engineering analysis and moderate amounts of capital investment; and *systems convert*, involving major changes in systems design, usually requiring substantial capital investment.
- Most of the 533 institutions responding to the survey have adopted those quick fix measures which could be implemented unilaterally by the physical plant manager. Few institutions have adopted those quick fix practices requiring the cooperation of the institutional community.
- While over half the respondents believed that the various refit measures listed should be implemented further, few reported significant progress in implementing such measures.
- One in five responding institutions has upgraded its boiler/chiller plants by converting to alternate fuel sources; 17 percent have begun to automate their power plants.
- In general, doctoral and comprehensive institutions have led other types of institutions in implementing conservation measures.
- Almost half of the responding institutions reported holding interruptible gas contracts; of these, 44 percent experienced some curtailment during 1974-75.

Background and Methods Summary

The impact of escalating energy costs upon the nation's colleges and universities has become a topic of widespread discussion, speculation, and concern. An ever-increasing share of institutional revenues is being spent to operate and maintain physical plants, most of which were designed during periods of inexpensive and plentiful fuel supply.

To assess more accurately the institutional impact of, and response to, the energy crisis, it is imperative to have a solid base of information on increases in energy costs and on the conservation measures being devised to contain them. Such data are essential for evaluating how effectively colleges and universities are adjusting to rapid changes in the cost and availability of energy and for determining how they may be assisted in their conservation efforts.

To those ends, HEP Survey #31 was initiated at the request of the U.S. Office of Education and the Energy Task Force (ETF). The purpose of the latter group—established in early 1975 and sponsored by the American Council on Education (ACE), the Association of Physical Plant Administrators (APPA), and the National Association of College and University Business Officers (NACUBO)—is to develop and implement programs that will encourage the efficient use of energy by colleges and universities and will foster awareness of emerging national energy policy.

The primary objectives of the survey were: (1) to measure the increase in energy expenditures since the OPEC Oil Embargo (which occurred in the winter of 1973-74); (2) to assess changes in energy consumption over a two-year period; and (3) to examine some of the specific conservation practices of higher education institutions. The years selected for study were the 1972-73 academic year (FY 1973), the year before the Embargo, and the 1974-75 academic year (FY 1975), the year after. Specifically, each respondent was asked to indicate, for each year, the amount of each type of fuel consumed and the total cost; the institution's involvement in three stages of energy conservation; and selected institutional experiences during the period of the Oil Embargo. Respondents were asked to report only the amounts of fuel used to maintain buildings and facilities; transportation fuel needs were excluded. Detailed statistical tables are contained in Appendix A.

Both the Office of Education and the ETF believed that the survey would serve as a useful educational tool, since the centralized collection of energy cost and consumption data is a critical first step in any effort to implement an energy management program. In addition, it was hoped that requesting information on the type of energy conservation measures taken by institutions would stimulate further conservation activity within higher education. Perhaps as important, the collaboration of several education associations (under the aegis of the Energy Task Force) with federal agencies would eliminate the need for multiple surveys covering the same ground.

The Higher Education Panel (HEP) is a continuing research program established by the American Council on Education in 1971 for the purpose of conducting quick-response surveys on topics of current policy interest to the higher education community and government agencies. The Panel is based upon a network of representatives at 642 colleges and universities broadly representative of the more than 3,000 institutions listed in the Office of Education's *Education Directory 1973-74*. All institutions in the population are categorized according to the Panel's stratification design; usually, these variables are: type (two-year college, four-year college, university), control (public, private), and size (total full-time equivalent enrollment).

Prior to the mailout of the energy survey, the ETF, through sponsoring associations, alerted institutions to the impending survey and asked their cooperation. The survey, mailed in early February 1976 to the presidents of all Panel institutions, asked that the responsibility for completion be assigned to the appropriate authority, usually the physical plant manager or the business officer. The HEP representative at each Panel institution also was informed of the survey and was asked to cooperate in every way possible. (See Appendix B for a copy of the survey instrument and accompanying letters.)

After the requested return date of March 1, 1976, nonrespondents were followed up by telephone and urged to complete the questionnaire. Second copies of the survey package were mailed to institutions requesting them. As of June 15, the cut-off date for questionnaire returns, usable data had been received from 536 of the 637 institutions surveyed, for a response rate of 84.1 percent.

The reported data were statistically adjusted to represent the population of 2,987 colleges and universities in the contiguous continental United States (i.e., excluding institutions in Alaska, Hawaii, Puerto Rico, etc.). Because of the subject matter covered, the Panel's normal institutional weighting procedure—based upon type, control, and size of institution—was deemed inappropriate.

Thus, in consultation with Joseph Steinberg, of Survey Design, Inc., a special stratification design was created for this survey. It involved a two-stage process using four variables—region, climate, intensiveness of energy use, and enrollment size—to weight the responses of the 536 institutions up to national estimates. Because level of energy use was found to be related to institutional type, the Carnegie Commission classifications of institutions were collapsed into three categories: (1) research and doctoral-granting universities and comprehensive universities and colleges (referred to throughout the text, for convenience, as *doctoral and comprehensive institutions;* (2) liberal arts and *other four-year colleges;* and (3) *two-year colleges and institutes.*[1] (See Appendix C for a more complete discussion of methodology and Appendix D for a comparison of respondents and nonrespondents.)

[1] Carnegie Commission on Higher Education, *A Classification of Institutions of Higher Education* (Berkeley, Calif.: Carnegie Commission on Higher Education), 1973.

Findings: Cost and Consumption

Nationally, institutions of higher education experienced a 70 percent increase in energy costs between the 1972-73 academic year and the 1974-75 academic year, from $555 million in the pre-Embargo year to $944 million in the post-Embargo year. During this interval, total energy consumption decreased by 6 percent despite increases in both plant size and enrollments. In the earlier year, institutions consumed an estimated total of 4.25 billion therms,[1] whereas in the later year the total was 4.01 billion therms.

On a unit basis, energy costs for all institutions averaged 13.1 cents per therm in the pre-Embargo year and 23.5 cents two years later, for an increase of 79 percent.

The extent to which an individual institution's energy costs increased during this period was, of course, dependent on the kinds of energy it used. Types of energy varied widely in costs per unit and percentage increases in costs as shown in Table 1.

Table 1: Energy Costs per Therm

Type of Energy	Dollars per Therm 1972-73	Dollars per Therm 1974-75	Percent Change
Oil	.082	.216	+163
Natural gas	.056	.092	+ 64
Coal	.055	.124	+126
Purchased electricity	.392	.615	+ 57

The unit cost of oil rose most sharply during the period, from 8.2 cents per therm to 21.6 cents,[2] an increase of 163 percent. Nationally, oil provided about one-fifth of the energy needs of academic institutions in both years studied (see Figure 1 for the distribution of energy consumed in 1974-75).

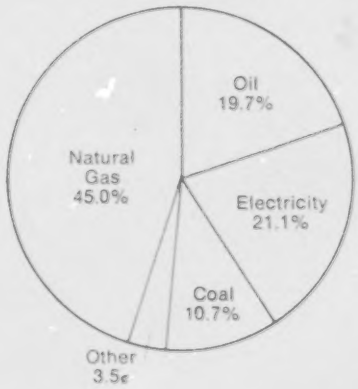
[1] One therm is the equivalent of 100,000 British thermal units (BTU).

[2] Some grades of fuel oil experienced greater unit-cost increases than others: The cost of #6 fuel oil rose 186 percent (from 7.4 to 21.2 cents per therm), while #2 fuel oil increased 124 percent (from 10.2 to 22.8 cents per therm).

This report discusses cost and consumption of all grades of fuel oil combined; however, the appendix tables present these data separately for those persons seeking such detail.

Natural gas, an energy source whose price is subject to government regulation in certain instances, increased only moderately in cost (64 percent), from 5.6 cents to 9.2 cents per therm, over the period. In 1974, it was the least expensive fuel, providing 45 percent of the energy consumed by higher education institutions.

Figure 1: 1974-75 Energy Consumption (in percentages)



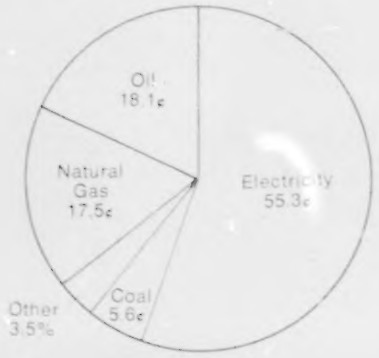
Coal, the cheapest fuel in pre-Embargo days (5.5 cents per therm), lost that status. In 1974-75 it cost 12.4 cents per therm, a 126 percent increase. Nationally, coal provided about 11 percent of the total energy consumed by academic institutions in both 1972-73 and 1974-75.

Though purchased electricity registered the smallest cost increase (57 percent) over the period, it was much more expensive than any other energy source both in 1972-73 (39.2 cents per therm) and in 1974-75 (61.5 cents per therm). Like oil, it provided about one-fifth of the energy consumed by higher education in both years.

Looking at the energy bill paid by academic institutions in 1974-75, one finds that purchased electricity accounted for a major share: 55.3 cents of every dollar spent for fuel. Coal and "other" fuel sources accounted for the smallest portion (5.6 cents and 3.5 cents, respectively).

About 18 cents each of the energy dollar was spent for natural gas and for oil (Figure 2).

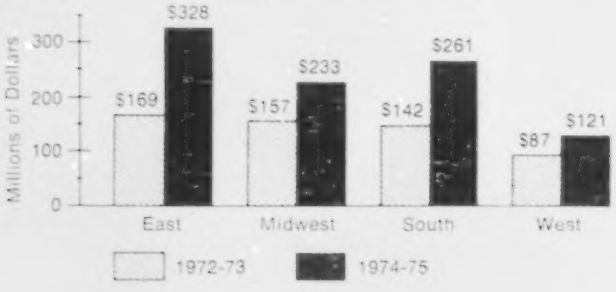
Figure 2: 1974 Energy Dollar



Regional Estimates

National figures, of course, oversimplify the complex and varying energy circumstances of different types of institutions. For instance, an institution's location profoundly affects what it pays for energy, not only because climatic conditions vary widely across the nation, but also because the availability and cost of specific types of fuel differ substantially from one region to another (see Figure 3).

Figure 3: Comparative Regional Energy Costs (in millions of dollars)



The percentage increases in total energy costs between 1972-73 and 1974-75 were greatest among institutions in the East and South (94 percent and 84 percent, respectively). Much smaller increases were experienced by institutions in the West (40 percent) and in the Midwest (48 percent).

Regional variations in costs per unit of energy are particularly striking. In 1972-73, institutions in the East paid 16.5 cents for each therm of energy consumed, whereas those in the Midwest, South, and West paid about 12 cents. In 1974-75, the unit cost paid by institutions in the East and South had doubled to 33.2 cents and 22.9 cents, respectively. Midwestern institutions paid 19.6 cents per therm, a 58 percent increase. Costs per therm at institutions in the West rose to 17.5 cents, a 50 percent increase. See Table 2 for a summary of these changes.

Table 2: Regional Changes in Energy Costs per Therm

Region	Dollars per Therm 1972-73	1974-75	Percent Change
East	.165	.332	+101
Midwest	.124	.196	+ 58
South	.116	.229	+ 97
West	.117	.175	+ 50

In the *East*, half of the energy used by academic institutions was supplied by oil. The unit costs for oil were very similar for institutions in all four regions of the nation, fluctuating between 21 and 22 cents. However, institutions in the East pay more for energy because of their greater dependence on oil, which has become a relatively expensive source of energy. Moreover, much of the purchased electricity in the East is generated by oil-fed turbines. Thus, oil is a component of the demand for both fuel and electricity.

Indeed, virtually all forms of energy cost more in the East than in other regions. Natural gas, for example, which supplied about 18 percent of the energy used by Eastern institutions, cost 13.8 cents per therm in the East during 1974-75 compared with 8-9 cents elsewhere. Similarly, purchased electricity was about one-third higher in the East (80.9 cents, compared with between 49 and 58 cents elsewhere). In FY 1975, more than half (53 percent) of the $328 million energy bill at colleges and universities in the East was spent for oil.

Coal was the only type of fuel which cost Eastern institutions less (12.3 cents per therm in 1974-75) than institutions in another region, the South, which paid 17.1 cents per therm. But in 1974-75, coal accounted for less than 10 percent of the energy consumption of institutions in the East, and this figure represents a drop from pre-Embargo coal consumption, probably because of newly imposed requirements for pollution control.

In the *Midwest*, natural gas was the dominant source of energy for academic institutions, providing slightly less than half of the energy consumed in both years studied. In 1974-75, natural gas was the cheapest form of energy at 9 cents per therm, whereas the cost of oil had more than doubled over the two-year period (to 20.6 cents per therm). Thus, it is not surprising to find that Midwestern institutions had decreased their oil consumption by 26 percent over the period, so that in 1974-75 it constituted only 10 percent of their total energy consumption.

Just over half of the $233 million energy bill footed by institutions in the Midwest went for purchased electricity, which provided about 18 percent of the 1.2 billion therms of energy they consumed.

In the *South*, institutions paid the second highest per-unit energy costs of the four regions: 22.9 cents per therm in 1974-75, compared with a high of 33.2 cents per therm at institutions in the East. The more than 900 institutions in the South paid almost $261 million for the 1.1 billion therms of energy they consumed in 1974-75. These figures represent a 7 percent reduction in consumption and an 84 percent increase in cost over the 1972-73 figures. The price hike in coal, the source of 9 percent of the energy consumed in 1974-75, was higher in the South than in any other region, 185 percent. The same was true for natural gas, which supplied over half the energy used by Southern colleges and universities in 1974-75 and increased in unit cost during the two-year period by 100 percent. But even though this increase was more than double that for any other region, it raised the cost of natural gas to only 9.2 cents per therm, the same as the estimated national average. Apparently differential price regulation for intra- and interstate natural gas accounts for this increase.

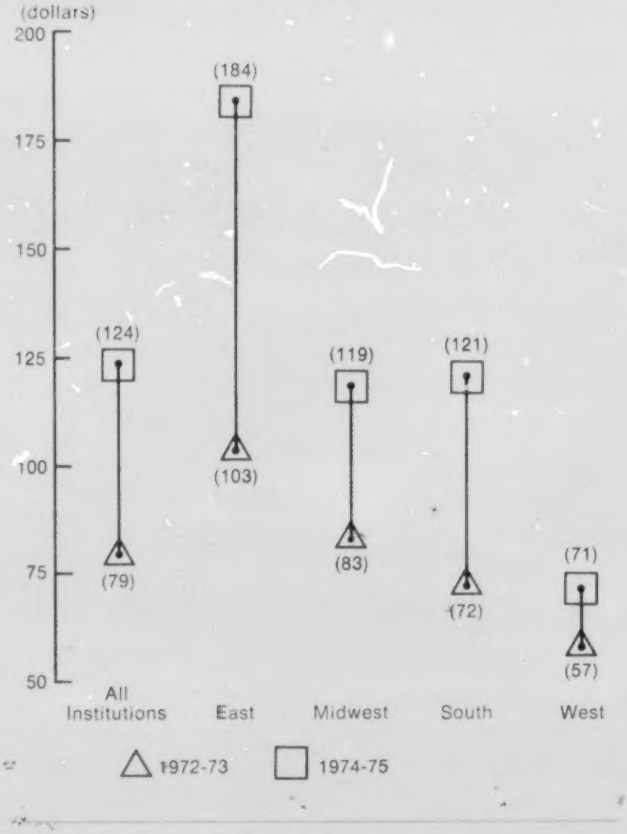
In the *West*, the approximately 460 institutions experienced the smallest increases in overall energy costs. In 1974-75, they paid about $121 million for energy, a 40 percent increase over 1972-73; their energy consumption dropped by 6 percent, to 693 million therms. The unit costs for all fuel at Western colleges and universities increased by 50 percent, from 11.7 cents to 17.5 cents per therm. Their average unit costs in 1974-75 were lower than those for institutions in other regions, primarily because of their heavy reliance on natural gas, which accounted for about two-thirds of the energy they consumed, at a cost of 7.6 cents per therm—43 percent less than the cost paid by institutions in the East, and about 11 percent less than that paid by institutions in the South and Midwest. Conversely, only 5 percent of their energy came from oil, the most expensive of the fossil fuels in the Western region.

In 1974-75, purchased electricity accounted for 62 percent of the total energy costs at institutions in the West—a larger proportion than at institutions in the Midwest (51 percent), East (53 percent), and South (58 percent). In all four regions, purchased electricity provided about one-fifth of the thermal units of energy consumed.

COST PER STUDENT. The impact of changes in energy costs on academic institutions in different regions of the country is perhaps best shown on a per-student basis. Figure 4 shows these changes from 1972-73 to 1974-75 by region.

Nationally, per-student energy costs rose 57 percent, from $79 per student in 1972-73 to $124 in 1974-75. But regional differences were striking. Institutions in the East, for example, paid $103 per student for energy in the pre-Embargo year, a figure well above not only the estimated national average but also the per-student costs in other regions. By 1974-75, Eastern colleges and universities were paying $184 per student for energy, a 78

Figure 4: Regional Energy Cost per Student (FTE) (in dollars)

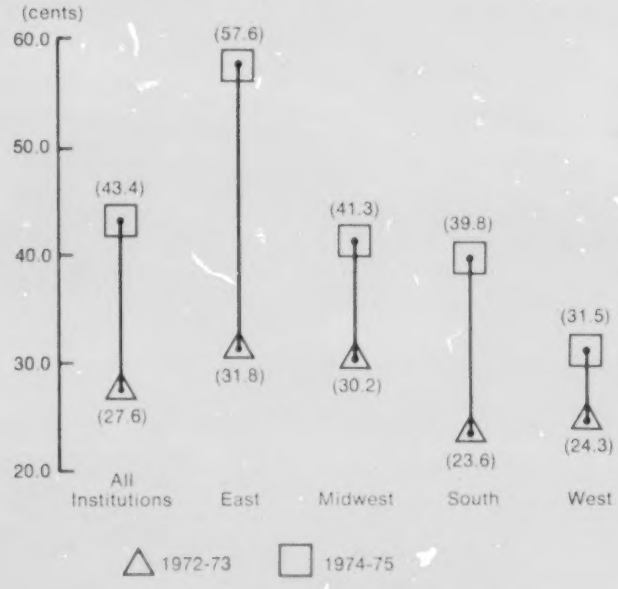


percent increase. At the other extreme, energy costs at institutions in the West amounted to only $57 per student in 1972-73 and $71 per student in 1974-75, a modest 25 percent increase. Thus, in the two-year period covered by the survey, the differential between Eastern and Western institutions in per-student energy costs widened from 82 percent to 159 percent. Per-student energy costs in the Midwest and South were more moderate both before and after the Oil Embargo: In 1972-73, institutions in these regions paid $83 and $72, respectively; and in 1974-75, they paid $119 and $121, respectively.

COST PER SQUARE FOOT. Calculated on the basis of cost per square foot of space being serviced, the pattern of changes in energy costs among the four regions is similar to that found for costs per student, as Figure 5 indicates.

Overall, energy costs rose from 27.6 cents per square foot in 1972-73 to 43.4 cents in 1974-75, an increase of 57 percent. Again, institutions in the East experienced the largest increase (81 percent) during this period, from 31.8 cents to 57.6 cents per square foot, whereas those in the West reported only a 30 percent increase, from a low 24.3 cents to a still relatively low 31.5 cents per square foot. Cost increases at institutions in the South

Figure 5: Regional Energy Cost per Square Foot (in cents)



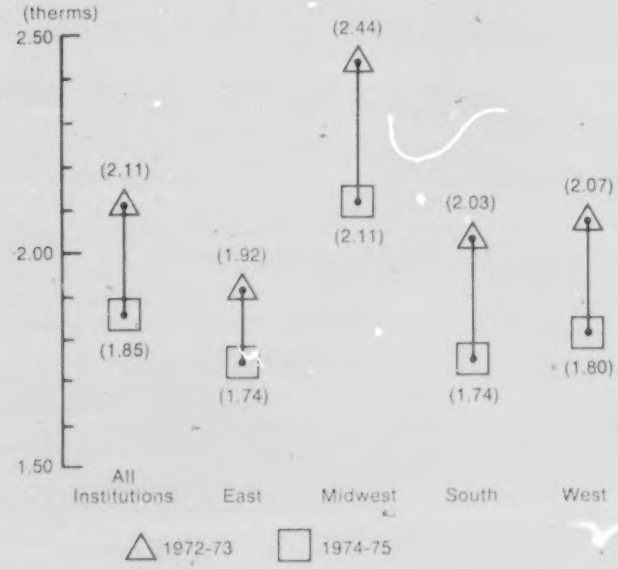
and in the Midwest fell between these two extremes, rising to 39.8 cents and 41.3 cents, respectively.

CONSUMPTION PER SQUARE FOOT. Obviously, energy costs have climbed substantially in most regions. But what of the relation between changes in cost and in consumption? Figure 5 shows shifts in the amounts of energy consumed by higher education institutions nationally and in each of the four regions, holding constant the square feet of space serviced by that energy, thereby providing a more meaningful indicator of the effect of conservation efforts on consumption.

In 1972-73, the nearly 3,000 institutions in the 48 contiguous states and the District of Columbia consumed about 2.11 therms of energy for each square foot of space serviced. In 1974-75, energy use was reduced by 12 percent, to 1.85 therms per square foot. The proportionate reduction in energy use was close to the national figure in all regions except in the East where the reduction was only 9 percent.

By 1974-75, institutions in the East and South had reduced their consumption levels to about 1.74 therms per square foot; in the West, to about 1.80 therms; and in the Midwest, to about 2.11 therms per square foot.

Figure 6: Regional Energy Consumption per Square Foot (in therms)



Proportion of Current Fund Expenditures Used for Energy

A higher education institution's current fund expenditures (CFE) are the costs incurred for the goods and services used in conducting institutional operations during one fiscal year. These costs include expenditures for educational and general purposes, for auxiliary enterprises, for hospitals, and for independent operations.

Thus on a year-to-year basis, CFE takes into account the inflationary and other cost increases involved in the administration of higher education. During the period covered by the survey, the CFE of academic institutions increased by 27 percent, from $27.9 billion in 1972-73 to $35.3 billion in 1974-75.[3]

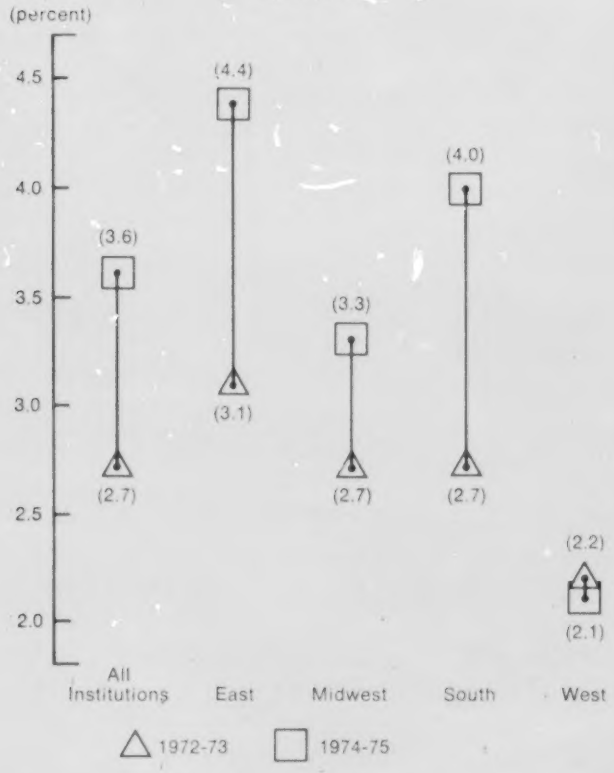
For all institutions combined, the median proportion of CFE spent for energy jumped from 2.7 percent in 1972-73 to 3.6 percent in 1974-75 (Figure 7). The energy-cost share of CFE was lowest for institutions in the West (2.2 percent in the earlier year and 2.4 percent in the later year) and highest for institutions in the East (3.1 percent in the pre-Embargo year, increasing to 4.4 percent in 1974-75). Institutions in the Midwest and South spent the same proportion of CFE on energy costs in 1972-73 (2.7 percent each) although the increase by 1974-75 was much greater in the South than in the Midwest.

Effects of Reliance on Specific Types of Fuel

As we have seen, an institution's location is an important determination of how it is affected by escalating energy costs. To some extent, an institution is also affected by the energy efficiency of its physical plant and the kinds of fuel its equipment can use. Of course, in many cases, an institution's location also influences its reliance on particular fuels, since some fuels are highly accessible in some regions and rather rare in others. In an attempt to identify more clearly the effects of reliance on specific fuels, the pattern of fuel usage at each institu-

[3] *A Fact Book on Higher Education: Demographic and Economic Data* (Washington: American Council on Education), 1975, p. 75.50; 1976, p. 76.62.

Figure 7: Median Percent of CFE Used for Energy by Region



tion was examined. This section presents data on those institutions which relied heavily on one fuel as their primary source of energy. The term *primary fuel type* was defined for each institution as *that fuel upon which the institution was most dependent, using the number of therms consumed as the measure of dependence.* Only three major groups of fuels burned by the institutions—oil, natural gas, and coal—were analyzed; purchased utilities (such as electricity and steam) were excluded from the analysis on the grounds that (a) they can be generated from a number of different sources and (b) most institutions purchase relatively large amounts of electricity or steam for a wide variety of purposes within their operations.

Since the analysis is limited to those institutions relying primarily on oil, natural gas, or coal, it does not cover all respondents. Weighted estimates indicate that, in 1974-75, approximately 2,300 of the 3,000 institutions in the population relied on one of the three groups of fossil fuels as their primary source of energy; the remaining institutions were dependent upon either purchased electricity, steam, or other energy sources.

It should be noted that the estimated number of institutions with primary reliance upon oil, natural gas or coal all decreased over the 1972-73 to 1974-75 period. Apparently a greater dispersal of consumption among the fossil fuels during the period resulted in a somewhat greater number of institutions developing a primary reliance on purchased electricity or other sources of energy which were excluded from the present analysis.

In 1972-73, the nearly 700 institutions whose primary fuel was oil (23 percent of all institutions in the population) spent $132 million for energy. By 1974-75, the number of institutions relying on oil was reduced by 9 percent, but their total energy costs had risen by 82 percent, to $239 million.

Well over half (57 percent) of all institutions represented in the survey relied on natural gas as their primary source of energy. Over the two-year period, their energy costs rose by 46 percent, from $267 million to $389 million. At the same time, the number of institutions using natural gas as their primary fuel dropped 7 percent, from an estimated 1,700 in 1972-73 to fewer than 1,600 in 1974-75.

Only 3 percent of the nation's higher education institutions used coal as a primary energy source, and their energy costs climbed from $51 million to $92 million during the period surveyed, a 79 percent increase. Although few in number, the 90-plus institutions using coal as their primary fuel were heavy users of energy. On the average, each coal-using institution spent over $500,000 for energy in 1972-73 and over $1 million in 1974-75. In contrast, energy costs at institutions relying on oil or natural gas averaged less than $200,000 in the earlier year and less than $400,000 in the later year.

On a unit-cost basis, institutions dependent primarily on oil paid more for their energy in both the pre- and the post-Embargo periods than did those dependent on other fuels and experienced a 116 percent unit-cost increase in that interval, from 15.3 cents to 33 cents per therm. In contrast, the unit-cost at institutions relying on natural gas or coal rose to only about 19 cents per therm by 1974-75.

When costs are calculated on a per-square foot or a per-student basis, one finds that institutions using oil as a primary fuel paid more for their energy than did those using natural gas or coal. Moreover, energy costs usually absorbed a greater share of their CFE. These differences are summarized in Table 3.

Table 3: Energy Facts About Primary Fuel Users

Total Energy Costs	Oil		Natural Gas		Coal	
	1972-73	1974-75	1972-73	1974-75	1972-73	1974-75
Cost per square foot	31.4¢	56.4¢	26.9¢	36.8¢	24.7¢	42.0¢
Cost per student	$118	$194	$79	$108	$87	$151
Median % of CFE	3.1%	4.8%	2.6%	3.2%	2.0%	3.8%

This summary table makes it clear that:

- On a unit-cost basis, institutions relying on oil as a primary energy source paid more for their energy in both

the pre-Embargo and the post-Embargo year.

- Coal as a primary fuel source was the cheapest of the three fuel types in 1972-73, but in the post-Embargo year, coal-using institutions lost their advantage. Their energy costs, whether calculated on a per-square foot or a per-student basis, were intermediate between those paid by oil-users and those paid by natural gas-users.
- Energy costs at institutions relying primarily on natural gas rose least over the period surveyed because of price regulation by the federal government.
- By 1974-75, total energy costs at institutions which used oil as their primary energy source amounted to $194 per student. The comparable costs for those relying on coal and on natural gas were $151 and $108, respectively.

Differences Among Types of Institutions

The domain of higher education comprises a broad mix of institutions which have diverse energy requirements. Obviously, the escalation of energy costs in recent years has had a sharper impact on some types of institutions than on others. To clarify this differential impact, it was necessary to distinguish between types of higher education institutions in terms of the scope of their energy needs. To this purpose, the domain was divided into three broad categories, which represent a collapsing of the categories used in the Carnegie Commission classification scheme. (See also Appendix C.) These categories, generally related to differences in energy requirements, are as follows:

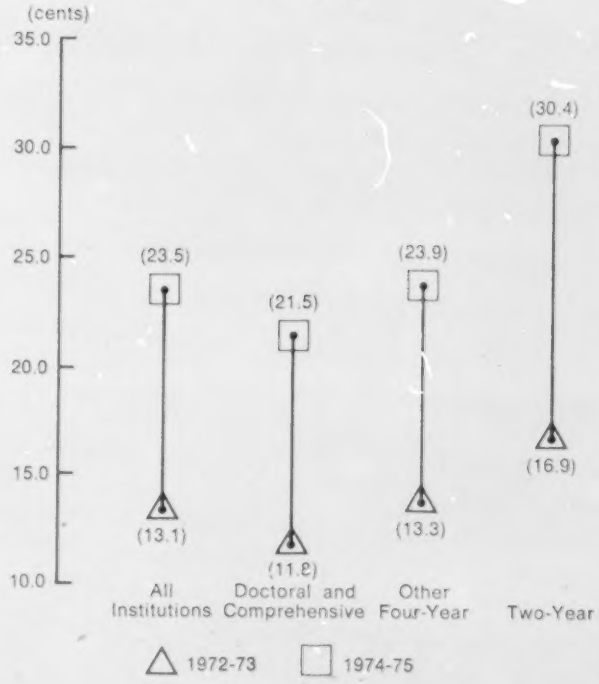
Category 1—Doctoral and Comprehensive Institutions: Characterized as high-intensity energy-users, institutions in this category make up one-fourth of the institutional population and include research and doctoral-granting universities, medical schools, technological institutes, and other universities and large four-year colleges which offer comprehensive programs.

Category 2—Other Four-Year Colleges: Characterized as moderate users of energy, institutions in this category include all other four-year institutions in the domain: primarily the traditional liberal arts colleges as well as more specialized four-year institutions which lack a technological emphasis (e.g., theological seminaries, teachers colleges). This group accounts for nearly two-fifths of the population.

Category 3—Two-Year Colleges: The third category includes all two-year colleges and institutes and, collectively, represents nearly two-fifths of the population. The rationale for putting these institutions in a separate category was a recognition that two-year institutions typically make more intensive use of their physical plants than do other institutions, often running two "shifts": a day school operation directed at full-time students, and a night school offering part-time study, usually for adult students.

Differences in Cost. Increases in the unit-cost of energy (dollars per therm) during the survey period were about the same, 80 percent, at all three categories of institutions, but cost levels differed. By 1974-75, doctoral and other comprehensive institutions were paying 21.5 cents per therm; other four-year institutions averaged 23.9 cents; and two-year institutions, 30.4 cents (Figure 8). These substantial differences in unit cost are probably attributable to differences in the average amount of energy used by institutions in each category. Typically, heavy energy-users pay lower unit costs. On the average, doctoral and comprehensive institutions used 9.38 million therms of energy per institution in 1974-75, while other four-year colleges averaged only 1.05 million therms, and two-year colleges averaged less than 400,000 therms. These unit-cost differences may also be affected by the mix of energy sources among types of institutions. For example, the larger category 1 institutions are more likely to burn coal and/or generate electricity on site.

Figure 8: Institutional Energy Cost per Therm (in cents)



A clearer view of how energy cost increases have affected the three categories of institutions is given by data showing the changes in cost per student, in cost per square foot, and in the proportion of an institution's CFE that goes for energy costs. These are summarized in Table 4.

In 1974-75, per-student energy costs were much lower at two-year institutions ($63) than at either the doctoral and comprehensive institutions ($162) or other four-year colleges ($136). Costs per square foot were also highest at doctoral and comprehensive institutions (49 cents, compared with about 40 cents at institutions in categories 2

Table 4: Energy Facts About Types of Institutions

Total Energy Costs	Doctoral and Comprehensive Institutions		Other Four-Year Colleges		Two-Year Colleges	
	1972-73	1974-75	1972-73	1974-75	1972-73	1974-75
Cost per square foot	29.9¢	49.1¢	24.8¢	39.7¢	30.9¢	41.0¢
Cost per student	$98	$162	$82	$136	$49	$63
Median % of CFE	2.0%	2.8%	2.7%	3.8%	2.8%	3.6%

and 3). The median share of current fund expenditures spent for energy, however, was lowest at doctoral and comprehensive institutions in both the pre- and post-Embargo years.

DIFFERENCES IN ENERGY CONSUMPTION. Energy consumption (as measured by therms used) declined between 1972-73 and 1974-75 at all three categories of institutions: Two-year colleges recorded the sharpest drop (15 percent), while doctoral and comprehensive institutions and four-year colleges reported more modest declines (5 and 3 percent, respectively). The three categories of institutions differed significantly, however, in their energy usage. Figures 9 and 10 show these differences in energy use and in the extent of reduction in consumption, after adjustments are made for changes both in physical plant size (square feet serviced) and in enrollments (FTE) over the period considered.

Overall, the nation's academic institutions reduced their energy consumption per square foot of space by 12 percent between 1972-73 and 1974-75. Two-year colleges effected a greater reduction (26 percent) that did either doctoral and comprehensive institutions (10 percent) or other four-year colleges (11 percent). Moreover, as Figure 9 indicates, two-year institutions averaged 1.35 therms of energy per square foot of space in 1974-75; energy consumption was 69 percent higher at doctoral and comprehensive institutions (averaging 2.28 therms per square foot) and 23 percent higher at other four-year colleges (averaging 1.66 therms per square foot).

Adjustment for enrollment changes during the period covered by the survey produced similar results (Figure 10). Two-year colleges used just over 200 therms of

Figure 9: Institutional Energy Consumption per Square Foot (in therms)

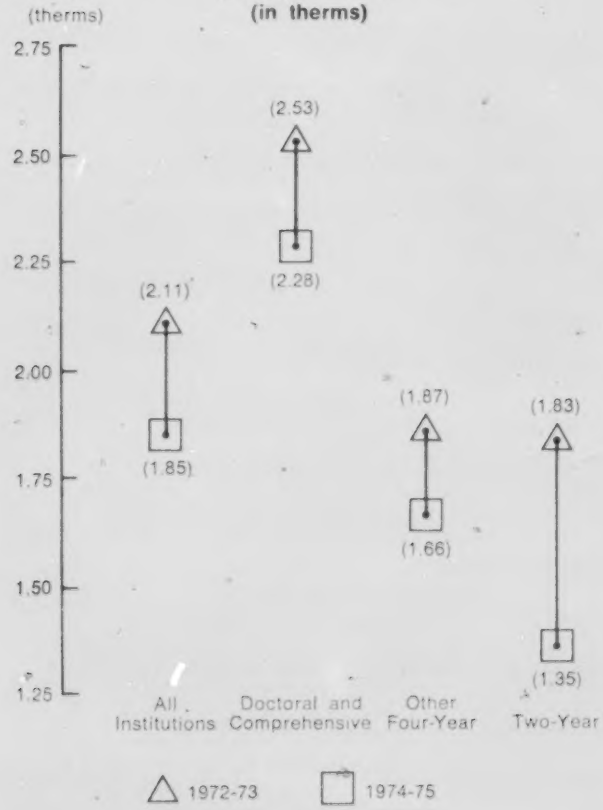
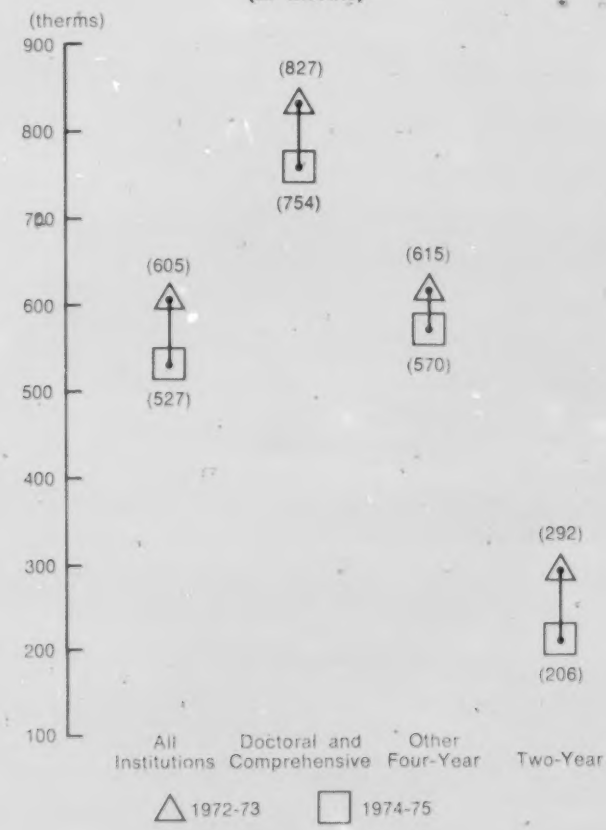


Figure 10: Institutional Energy Consumption per Student (FTE) (in therms)



energy per student in 1974-75, a 30 percent decrease from the earlier year. Doctoral and comprehensive institutions reduced their energy consumption by 9 percent, to 754 therms per student in the latter year. The reduction at other four-year colleges was 7 percent, to 579 therms per student. Thus, two-year colleges not only used less than one-third the therms per student used by the other institutional categories—a difference probably attributable to their narrower application of energy (primarily heating, cooling, and lighting)—but also substantially reduced their energy consumption over the period. As the next section (on conservation practices) indicates, these reductions are partly the result of their extensive efforts to consolidate their activities into less space.

Findings: Conservation Practices

While the cost data discussed above focus attention on the financial squeeze being experienced by higher education because of escalating energy prices, the consumption data make it clear that colleges and universities are actively involved in conservation programs designed to reduce waste and to contain energy costs. With existing educational facilities totaling approximately 2 billion square feet, and with the energy needed to service these facilities now costing more than $1 billion annually, even seemingly minor conservation efforts can produce significant savings.

For purposes of this analysis, the survey questionnaire contained a section on conservation practices (see Appendix B) that was based on a concept of phased implementation of energy conservation measures. Since its inception in early 1975, the Energy Task Force has organized its efforts to promote conservation practices around one concept: simply, that higher education institutions can maximize their conservation efforts by following a logical, carefully planned program moving from the most elementary conservation steps to levels of increasing sophistication. Starting with rather inexpensive and obvious (quick fix) measures and moving on to more complex, capital-intensive (refit and systems convert) activities, colleges and universities can reasonably expect to reduce energy consumption by up to 40 percent. Definitions and illustrations of the three phases follow.[1]

Phase 1—Quick Fix: These are modifications that achieve rapid and significant energy savings at a negligible cost or at a cost that produces a return on investment in no more than six months. Quick fix measures can normally be carried out by the regular operating and maintenance staff employed by colleges and universities. Activities such as adjusting temperatures and reducing illumination levels will quickly eliminate obvious energy waste and reduce consumption by at least 10 percent in most institutions. Moreover, if campus-wide cooperation can be gained, little time is required to implement quick fix measures. Some examples of these measures are as follows:

- Reducing illumination levels and lamp wattage
- Closing down buildings during nights and weekends
- Consolidating activities into fewer buildings, particularly during evenings and weekends
- Scheduling vacations during energy-intensive periods
- Restricting appliance usage and air conditioning installation
- Reducing hot water temperature
- Adjusting work schedules to maximize daylight hours
- Installing blinds and drapes to reduce heat leakage
- Reviewing current energy systems:
  - Inspecting steam traps
  - Inspecting valve functions and air filtration systems
  - Installing stack emission monitors
- Involving the entire institutional community:
  - Establishing a faculty-staff-student energy committee
  - Appointing building energy monitors
  - Holding energy briefing sessions with building occupants

Phase 2—Refit: These energy conservation modifications, which can yield an additional 10-15 percent energy reduction over and above that already gained through quick fix measures, have an estimated payback period of six months to three years. The success of refit modifications depends heavily on expert engineering analysis and careful study of modification options in order to insure cost-effective use of capital. Since the amount of capital available to an institution at any given time is limited, extreme care must be taken to establish clearly defined refit priorities so that they reflect the particular circumstances of the institution. Sound refit policy for one institution may be inappropriate for another, although—as the data below indicate—certain groups of refit measures have proven cost-effective at most colleges and universities throughout the country. Some examples of refit measures are as follows:

[1] Abstracted from Energy Task Force, *Energy Conservation: The Capital Investment Needs for Building Rehabilitation for Non-Profit Educational Institutions*, Paper #2 (Washington: Energy Task Force), 1975.

- Conducting technical studies:
  - Classifying buildings by function, energy consumption, and costs per square foot
  - Reviewing existing mechanical systems and controls to identify capital investment options
  - Identifying heat loss through infra-red photography
  - Analyzing electrical rate structures, power factors, load profiles, and demand peaks
  - Developing energy-efficient space allocation practices
- Modifying lighting systems:
  - Converting from incandescent to fluorescent fixtures
  - Installing time clocks on lighting systems
  - Revising light switch circuitry to reduce overlighting
- Reducing heating and air conditioning system losses:
  - Increasing steam-line insulation
  - Insulating roofs and walls
  - Utilizing weatherstripping, storm windows, caulking, sun-screens, blinds
- Refining of HVAC control systems:
  - Rezoning heating systems
  - Installing timers on exhaust and air handling systems
  - Installing variable speed drives on motors
  - Installing motorized steam valves
  - Reducing fresh air makeup

Phase 3—Systems Convert: These modifications are the most sophisticated and capital-intensive, usually requiring major changes in systems design. They generally can yield another 10 percent in energy savings, over and above those achieved by refit and quick fix measures, but have an estimated payback period of from two to five years. Institutions that specialize in health care and basic research and other energy-intensive activities usually benefit most from such measures. Consistent with the phased approach to energy management, systems convert measures are normally considered only after thorough, ongoing quick fix and refit programs have been implemented. As with refit modifications, systems convert requires a comprehensive engineering analysis before capital is allocated. Some examples of systems convert measures are as follows:

- Installing central computerized controls and building monitoring systems
- Installing waste heat recovery systems
- Converting building systems:
  - Introducing solar energy systems
  - Installing independently zoned environment controls for laboratories and other specialized space
  - Rewiring major electrical systems to minimize demand charges and avoid establishing new peaks
- Upgrading primary boiler and chiller plants:
  - Converting to alternate fuel sources
  - Automating power plants
  - Utilizing solid waste recovery fuel systems

The survey items dealing with conservation measures do not purport to be all-inclusive; rather, the list is a brief summary of representative conservation measures from each of the three phases and is intended to further the respondent's understanding and awareness of the energy management process and its potential for higher education. In this analysis, responses were not weighted to approximate national estimates. It was felt that the response patterns to items of such specificity could not be meaningfully generalized to the population of institutions as a whole. Therefore, the data shown represent only the 533 institutions responding to the items on conservation practices.

An Overview of Institutional Measures for Energy Conservation

Figures 11-13 summarize the extent to which the 533 institutional respondents have adopted the specific conservation measures listed in the survey.

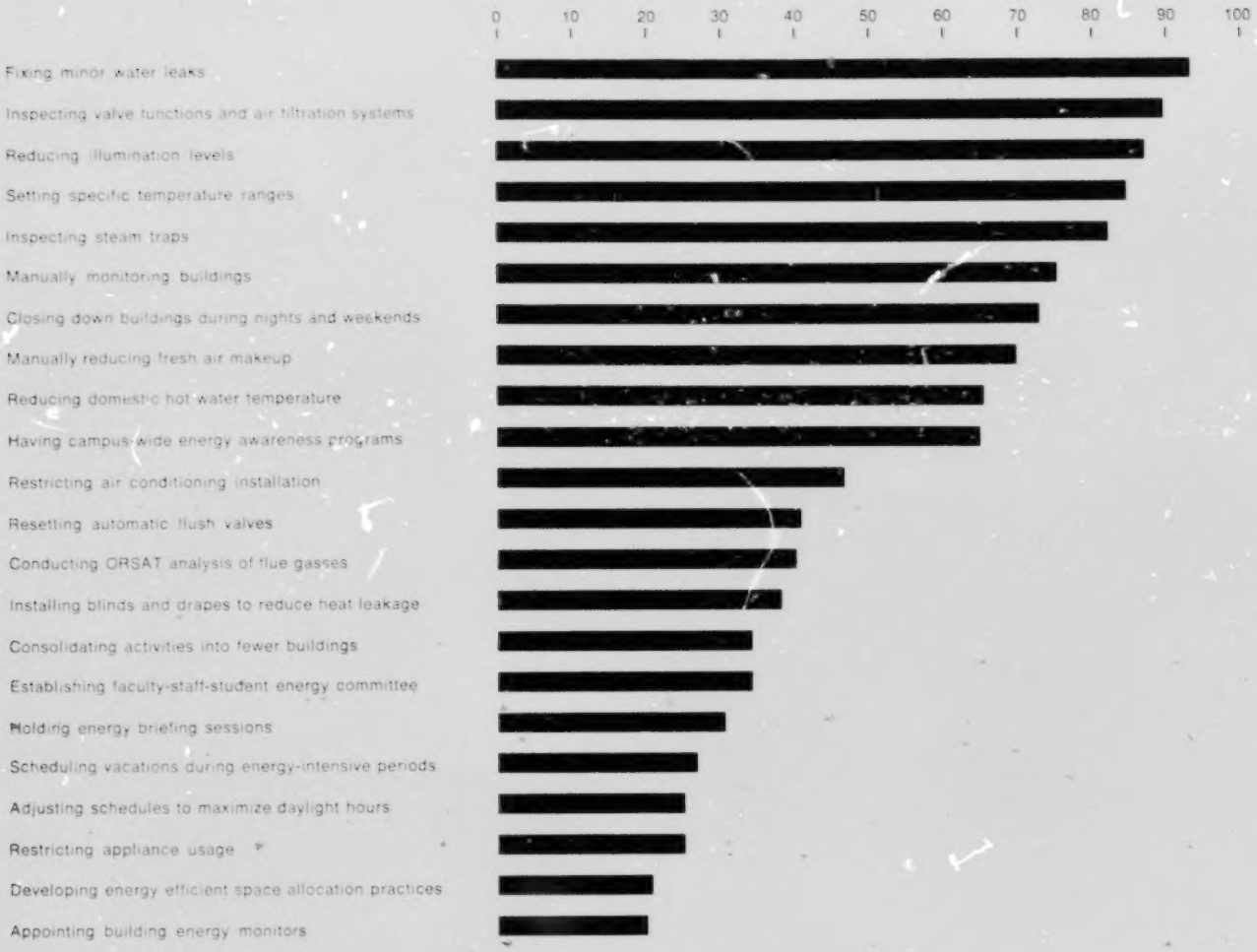
QUICK FIX MEASURES. As Figure 11 indicates, the majority of institutions have implemented most of the measures that can be effected centrally and unilaterally by physical plant managers: e.g., reducing illumination levels and lamp wattage (87 percent), reducing hot water temperature (66 percent), manually monitoring buildings (76 percent), adjusting thermostat settings to conserve energy (85 percent).

It is also evident, however, that relatively few institutions have adopted the quick fix conservation measures that require substantial accommodation and cooperation by energy-users within the institution: e.g., consolidating activities into fewer buildings, particularly during evenings and weekends (34 percent); scheduling vacations during energy-intensive periods (27 percent), adjusting work schedules to maximize daylight working hours (25 percent), developing energy-efficient space allocation practices (21 percent).

Similarly, very few institutions reported major programs to involve the institutional community in energy conservation efforts: e.g., appointing faculty, staff, and students to energy committees (34 percent), holding energy briefing sessions with building occupants (31 percent), appointing building energy monitors (20 percent).

REFIT MEASURES. Respondents reported their institutions' involvement with each of the refit and systems convert measures on a five-point scale as follows: (1) not done, not applicable; (2) not done, would like to do; (3) partially completed, not practical to do more; (4) partially completed, would like to do more; (5) completed. Unlike quick fix measures, the applicability of refit modifications varies considerably from institution to institution, depending on location, size, type, primary fuels, and the amount of capital available and allocated for energy conservation. As Figure 12 shows, most institutions have not yet progressed far into the refit phase. Of all the refit measures listed on the survey questionnaire, only two had been fully completed by at least one in five responding institutions: analyzing the electrical rate structure, power factors, load profiles, and demand

Figure 11: Percent of Institutions Implementing Quick Fix Measures (N = 533)



peaks (20 percent), and installing time clocks on lighting systems (21 percent).

Many respondents, however, believed that additional refit measures should be implemented at their institutions. On 16 of the 19 refit items listed, at least half of the respondents said that it would be desirable to initiate or complete such measures at their institutions. Apparently, many institutions are being constrained from doing so by either lack of capital or lack of commitment and support from all segments of the institutional community, or both.

SYSTEMS CONVERT MEASURES. As Figure 13 shows, no more than one in five responding institutions had completed any of the eleven systems convert measures listed in the survey questionnaire, though 27 percent indicated that, to the extent possible, they had converted primary boiler/chiller plants to alternate fuel sources. An additional 23 percent said they would like to start or do further work on such conservation measures. But almost half (49 percent) stated that such conversions were not applicable in their circumstances.

Another 27 percent indicated they had automated their power plants as fully as was practical. One in three indicated a desire to initiate or further implement such automation. The remaining 37 percent reported that conversion to automation was not applicable to their institutional setting.

In summary, few institutions have undertaken systems convert measures. Such conversion requires large capital expenditures, as well as engineering analysis and expertise. Further, as noted earlier, institutions must wait considerably longer than is the case with quick fix and refit measures to get a return on their investment. Undoubtedly, such modifications—and the capital they require—must compete with other institutional priorities

Figure 12: Implementation of Refit Measures
(N ≈ 530)

0 10 20 30 40 50 60 70 80 90 100
Classifying buildings by function, energy consumption, etc.
Reviewing existing systems to identify capital investment options
Identifying heat loss by infrared photography
Analyzing electrical rate structures, power factors, etc.
Converting from incandescent to fluorescent fixtures
Utilizing time clocks on lighting systems
Revising circuitry to reduce overlighting
Using task vs. area lighting
Increasing steam line insulation
Insulating roofs and walls
Utilizing weatherstripping, storm windows, etc.
Rezoning heating, cooling systems
Installing timers on exhaust and air handling systems
Installing variable speed drives
Installing motorized steam valves
Automatically reducing fresh air makeup
Centralized monitoring of buildings
Installing solenoid valves
Installing flow restrictors
0 10 20 30 40 50 60 70 80 90 100
Not done, not applicable
Not done, would like to do
Partially completed, not practical to do more
Partially completed, would like to do more
Completed

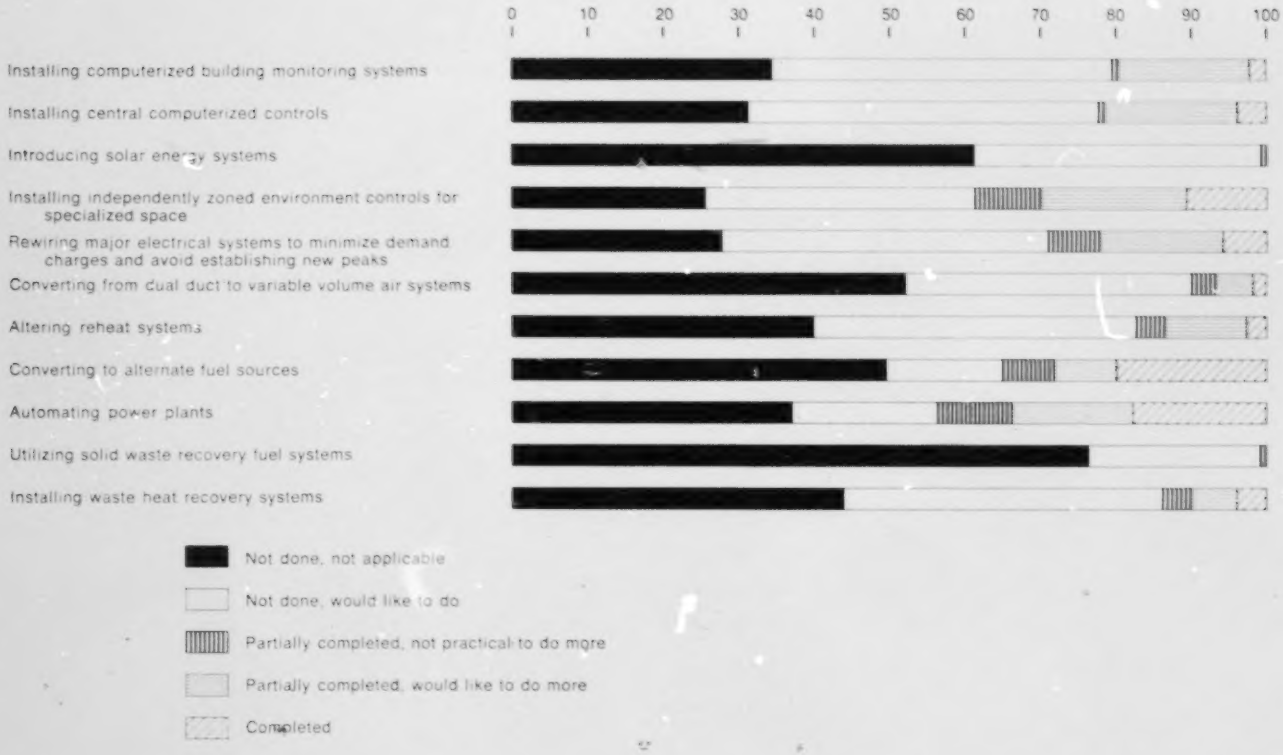
that, up to this point, have seemed more urgent.

Regional Differences in Conservation Practices

The survey questionnaire asked respondents to indicate which of 23 quick fix measures, 19 refit measures, and 11 systems convert measures had been implemented at their institutions.

Institutions in the East were more likely than those in other regions to implement quick fix measures. Refit measures were most often reported by institutions in both the East and the West. In general, relatively few systems convert measures were adopted by institutions in any region (see Appendix Table A-20), although somewhat higher proportions of Western institutions reported converting to alternate fuel sources (47 percent), installing independently zoned environment controls for labs and other specialized space (42 percent), and installing central computerized controls (30 percent). Midwestern institutions led those in other regions in the following forms of systems conversion: automation of power plants (52 percent), rewiring of major electrical systems (38 percent), and conversion from dual duct to variable

Figure 13: Implementation of Systems Convert Measures
(N = 527)



volume air systems (15 percent).

Institutional Differences in Conservation Practices

In general, greater proportions of the doctoral and comprehensive institutions than of the other two categories of institutions have implemented the conservation measures listed in the survey, and they tended to report greater involvement in all three phases of conservation.

Doctoral and comprehensive institutions reported the highest participation in 35 (66 percent) of the 53 listed measures, including 12 in the quick fix phase, 15 in the refit phase, and 8 in the systems convert phase. Other four-year colleges had the highest participation rates in only 7 of the measures shown, and two-year colleges in 11. Doctoral and comprehensive institutions were particularly advanced in the refit and systems convert phases; as Tables A-19 and A-20 show, however, even among these institutions refit and systems convert measures were completed only rarely at the time of the survey.

Other Factors Affecting Conservation Practices

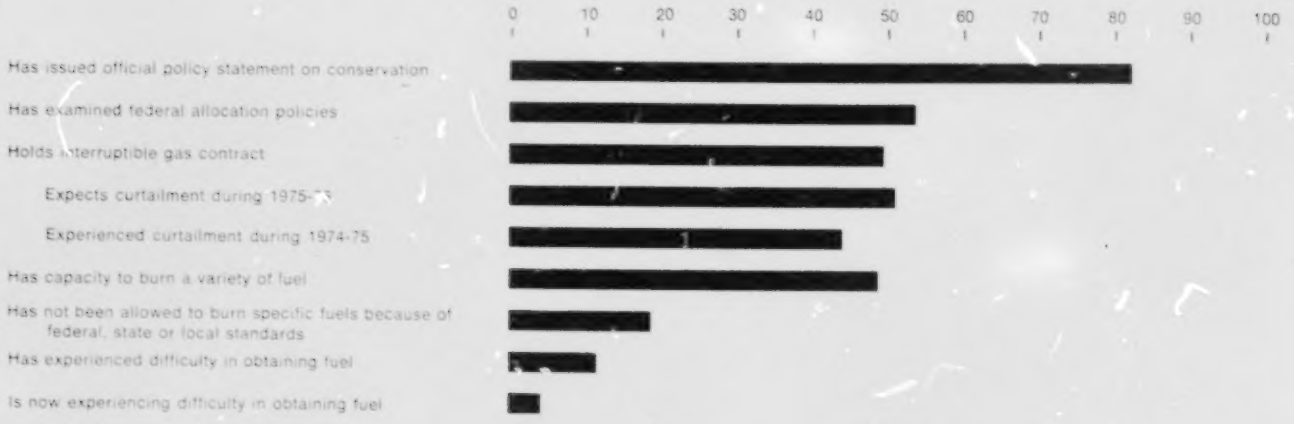
The survey questionnaire also asked general questions about experiences and external constraints relating to energy use which could affect an institution's ability to alter its energy circumstances. Selected responses about such factors are summarized in Figure 14.

Overall, almost half of the reporting institutions have the capacity to burn more than one kind of fuel. However, it is realized that some of the institutions that can burn alternative fuels can do so only for short periods of time since the systems typically are designed for a particular type of fuel. Capability for alternative fuel use varies considerably among types of institutions, with 64 percent of the doctoral and comprehensive institutions having such capability, compared with only 32 percent of the two-year institutions. (See Table A-21.)

Few institutions reported having difficulty in obtaining fuel in the past (12 percent), and fewer still (4 percent) indicated such difficulty at the time of the survey (February 1976). It seems likely, however, that many institutions—particularly those whose primary fuel is natural gas--have had problems in obtaining fuel during winter 1976-77. Almost half of the responding institutions reported having interruptible gas contracts. Of these, more than two-fifths (44 percent) experienced some curtailment during 1974-75, and over half had expected curtailments during 1975-76.

Almost one-fifth (19 percent) of the responding insti-

Figure 14: Percent of Institutions Reporting Various Experiences
(N = 533)



tutions indicated that federal, state, or local standards had prevented them from burning specific types of fuel. Fuel restrictions affected one in three doctoral and comprehensive institutions but only 15 percent of other four-year colleges and 3 percent of two-year institutions. Regionally, such restrictions have affected a greater proportion of the responding institutions in the East and West (34 percent and 20 per cent, respectively), compared with those in the Midwest and South (11 percent and 12 percent, respectively).

Appendix A: Detailed Statistical Tables

NOTES: Detail may not add to totals because of weighting and rounding. This is also true of the number of institutions included in the tables showing national estimates.

The number of institutions may vary from 1972-73 to 1974-75 because of reporting differences and subsequent weighting. Some institutions were able to report data for one year but not the other; thus any differential response may be magnified by weighting.

All cost and consumption data (Tables A-1–A-17) represent weighted national estimates. Data on conservation practices (Tables A-18–A-21) are unweighted and represent survey respondents only.

Table A-1
Percent of Current Funds Expended for Fuel: All Institutions

Percent of Current Fund Expenditures	1972-73 N	1972-73 Percent	1974-1975 N	1974-1975 Percent
≤1.0%	144	4.8	56	1.9
1.1-2.0%	654	22.0	396	13.3
2.1-3.0%	1049	35.3	548	18.5
3.1-4.0%	721	24.3	820	27.6
4.1-5.0%	246	8.3	557	18.8
5.1-6.0%	15	.5	375	12.7
6.1-7.0%	119	4.0	104	3.5
7.1-8.0%	0	0	49	1.7
>8.0%	22	.7	113	3.8
Total	2970	100.0	2969	100.0

Table A-2
Median Percent of Current Funds Expended for Fuel by Selected Institutional Characteristics

Institutional Characteristics	1972-73	1974-75
Total	2.7	3.6
Census Region		
East	3.1	4.4
Midwest	2.7	3.3
South	2.7	4.0
West	2.2	2.1
Primary Fuel		
Oil	3.1	4.8
Natural gas	2.6	3.2
Coal	3.0	3.8
Type		
Doctoral and comprehensive institutions	2.0	2.8
Other four-year colleges	2.7	3.8
Two-year colleges	2.8	3.6

Table A-3

Fuel Consumption and Cost: All Institutions

Type of Fuel	1972-73 N	1972-73 Therms Consumed (in thousands)	1972-73 Total Cost (in thousands)	1972-73 Dollars Per Therm	1974-75 N	1974-75 Therms Consumed (in thousands)	1974-75 Total Cost (in thousands)	1974-75 Dollars Per Therm	Percent Change N	Percent Change Therms Consumed	Percent Change Total Cost	Percent Change Dollars Per Therm
Fuel oil, total	1703[a]	923,574	75,418	.082	1692[a]	789,009	170,812	.216	- .6	-14.6	126.5	163.4
#6 Fuel oil	466	618,974	46,096	.074	458	525,577	111,279	.212	- 1.7	-15.1	141.4	186.5
#5 Fuel oil	194	51,513	4,235	.082	171	37,096	8,136	.219	-11.9	-28.0	92.1	167.1
#4 Fuel oil	238	55,906	4,689	.087	239	47,178	10,618	.225	.4	-15.6	117.2	158.6
#2 Fuel oil	1355	197,181	20,198	.102	1372	179,158	40,779	.228	1.3	- 9.1	101.9	123.5
Natural gas	2342	1,904,670	106,963	.056	2349	1,807,878	165,570	.092	.3	- 5.1	54.8	64.3
Coal	233	474,146	26,190	.055	236	429,835	53,247	.124	1.3	- 9.3	103.3	125.5
Purchased electricity	2844	842,116	330,068	.392	2865	845,841	520,475	.615	.7	.4	57.7	56.9
Purchased steam	61	76,679	14,467	.189	85	105,341	30,176	.286	39.3	37.4	108.6	51.3
Propane	56	1,016	156	.154	75	1,298	425	.327	33.9	27.8	172.4	112.3
Other	34	27,214	1,544	.057	14	34,213	3,164	.092	-58.8	25.7	104.9	61.4
Total	2982	4,249,415	554,806	.131	2984	4,013,415	943,869	.235	.1	- 5.6	70.1	79.4

[a]Unduplicated total of institutions using oil.

Table A-4

Fuel Consumption and Cost: Institutions in the East

Type of Fuel	1972-73 N	1972-73 Therms Consumed (in thousands)	1972-73 Total Cost (in thousands)	1972-73 Dollars Per Therm	1974-75 N	1974-75 Therms Consumed (in thousands)	1974-75 Total Cost (in thousands)	1974-75 Dollars Per Therm	Percent Change N	Percent Change Therms Consumed	Percent Change Total Cost	Percent Change Dollars Per Therm
Fuel oil, total	649[a]	509,090	41,206	.081	646[a]	447,287	100,086	.224	- .5	-12.1	142.9	176.5
#6 Fuel oil	268	379,050	27,732	.073	245	326,903	70,683	.216	- 8.6	-13.8	154.9	195.9
#5 Fuel oil	55	14,654	1,269	.087	46	11,359	2,569	.226	-16.4	-22.5	102.4	159.8
#4 Fuel oil	183	52,295	4,555	.087	168	40,301	8,921	.221	- 8.2	-22.9	95.9	154.0
#2 Fuel oil	500	63,091	7,650	.121	509	68,724	17,913	.261	1.8	8.9	134.2	115.7
Natural gas	457	144,018	13,492	.094	470	175,864	24,307	.138	2.8	22.1	80.2	46.8
Coal	78	123,673	6,312	.051	68	98,590	12,140	.123	-12.8	-20.3	92.3	141.2
Purchased electricity	765	207,359	99,782	.481	775	215,196	174,157	.809	1.3	3.8	74.5	68.2
Purchased steam	32	30,979	7,712	.249	36	47,547	16,469	.346	12.5	53.5	113.6	39.0
Propane	11	333	53	.159	9	322	104	.323	-18.2	- 3.3	96.2	103.1
Other	4	6,882	462	.067	3	5,830	1,163	.199	-25.0	-15.3	151.7	197.0
Total	786	1,022,334	169,019	.165	784	990,636	328,426	.332	- .3	- 3.1	94.3	101.2

[a]Unduplicated total of institutions using oil.

Table A-5

Fuel Consumption and Cost: Institutions in the Midwest

Type of Fuel	1972-73 N	1972-73 Therms Consumed (in thousands)	1972-73 Total Cost (in thousands)	1972-73 Dollars Per Therm	1974-75 N	1974-75 Therms Consumed (in thousands)	1974-75 Total Cost (in thousands)	1974-75 Dollars Per Therm	Percent Change N	Percent Change Therms Consumed	Percent Change Total Cost	Percent Change Dollars Per Therm
Fuel oil, total	452[a]	165,437	13,420	.081	460[a]	122,592	25,196	.206	1.8	-25.9	87.7	154.3
#6 Fuel oil	73	81,528	6,295	.077	63	63,170	13,825	.219	-13.7	-22.5	119.6	184.4
#5 Fuel oil	28	7,547	570	.076	25	4,691	1,015	.216	-10.7	-37.8	78.1	184.2
#4 Fuel oil	4	1,347	119	.088	4	1,129	276	.244	0	-16.2	131.9	177.3
#2 Fuel oil	373	75,015	6,436	.086	388	53,602	10,080	.188	4.0	-28.5	56.6	118.6
Natural gas	790	610,898	38,382	.063	802	588,129	52,901	.090	1.5	- 3.7	37.8	42.9
Coal	74	240,193	13,434	.056	52	222,253	23,320	.105	-29.7	- 7.5	73.6	87.5
Purchased electricity	771	212,094	85,766	.404	773	213,243	119,848	.562	.3	.5	39.7	39.1
Purchased steam	23	36,904	6,039	.164	26	44,290	11,913	.269	13.0	20.0	97.3	64.0
Propane	11	75	13	.173	11	68	21	.309	0	- 9.3	61.5	78.6
Other	3	145	166	1.145	0	--	--	--	-100.0	-100.0	-100.0	-100.0
Total	815	1,265,746	157,220	.124	814	1,190,575	233,199	.196	- .1	- 5.9	48.3	58.1

[a]Unduplicated total of institutions using oil.

Table A-6
Fuel Consumption and Cost: Institutions in the South

Type of Fuel	1972-73 N	1972-73 Therms Consumed (in thousands)	1972-73 Total Cost (in thousands)	1972-73 Dollars Per Therm	1974-75 N	1974-75 Therms Consumed (in thousands)	1974-75 Total Cost (in thousands)	1974-75 Dollars Per Therm	Percent Change N	Percent Change Therms Consumed	Percent Change Total Cost	Percent Change Dollars Per Therm
Fuel oil, total	409[a]	173,017	13,709	.079	384[a]	182,563	37,683	.206	- 6.1	5.5	174.9	160.8
#6 Fuel oil	94	105,446	7,099	.067	98	115,067	22,857	.199	4.3	9.1	222.0	197.0
#5 Fuel oil	62	17,565	1,384	.079	65	14,366	3,017	.210	4.8	-18.2	118.0	165.8
#4 Fuel oil	24	368	42	.114	35	4,406	1,033	.234	45.8	97.3	359.5	105.3
#2 Fuel oil	346	49,638	5,184	.104	330	48,724	10,776	.221	- 4.6	- 1.8	107.9	112.5
Natural gas	674	676,244	30,803	.046	675	583,546	53,467	.092	.1	-13.7	73.6	100.0
Coal	77	103,176	6,147	.060	88	98,505	16,833	.171	14.3	- 4.5	173.8	185.0
Purchased electricity	867	260,602	90,507	.347	869	263,138	151,379	.575	.2	1.0	67.3	65.7
Purchased steam	6	8,796	716	.081	7	11,523	1,391	.121	16.7	31.0	94.3	49.4
Propane	12	23	5	.217	31	171	53	.310	158.3	643.5	960.0	42.9
Other	0	--	--	--	0	--	--	--	--	--	--	--
Total	923	1,221,858	141,887	.116	922	1,139,446	260,806	.229	- .1	- 6.7	83.8	97.4

[a]Unduplicated total of institutions using oil.

Table A-7

Fuel Consumption and Cost: Institutions in the West

Type of Fuel	1972-73 N	1972-73 Therms Consumed (in thousands)	1972-73 Total Cost (in thousands)	1972-73 Dollars Per Therm	1974-75 N	1974-75 Therms Consumed (in thousands)	1974-75 Total Cost (in thousands)	1974-75 Dollars Per Therm	Percent Change N	Percent Change Therms Consumed	Percent Change Total Cost	Percent Change Dollars Per Therm
Fuel oil, total	193[a]	76,030	7,083	.093	202[a]	36,567	7,847	.215	4.7	-51.9	10.8	131.2
#6 Fuel oil	31	52,950	4,970	.094	52	20,437	3,914	.192	67.7	-61.4	-21.2	104.3
#5 Fuel oil	49	11,747	1,012	.086	35	6,680	1,535	.230	-28.6	-43.1	51.7	167.4
#4 Fuel oil	27	1,896	173	.091	32	1,342	388	.289	18.5	-29.2	124.3	217.6
#2 Fuel oil	136	9,437	928	.098	145	8,108	2,010	.248	6.6	-14.1	116.6	153.1
Natural gas	421	473,510	24,286	.051	402	460,339	34,895	.076	- 4.5	- 2.8	43.7	49.0
Coal	4	7,104	297	.042	28	10,487	954	.091	600.0	47.6	221.2	116.7
Purchased electricity	441	162,061	54,013	.333	448	154,264	75,091	.487	1.6	- 4.8	39.0	46.2
Purchased steam	0	--	--	--	16	1,981	403	.203	--	--	--	--
Propane	22	585	85	.145	24	737	247	.335	9.1	26.0	190.6	131.0
Other	27	20,187	916	.045	11	28,383	2,001	.070	-59.3	40.6	118.4	55.6
Total	458	739,477	86,680	.117	464	692,758	121,438	.175	1.3	- 6.3	40.1	49.6

[a]Unduplicated total of institutions using oil.

Table A-8

Fuel Consumption and Cost: Institutions Whose Primary Fuel[a] Is Oil

Type of Fuel	1972-73 N	1972-73 Therms Consumed (in thousands)	1972-73 Total Cost (in thousands)	1972-73 Dollars Per Therm	1974-75 N	1974-75 Therms Consumed (in thousands)	1974-75 Total Cost (in thousands)	1974-75 Dollars Per Therm	Percent Change N	Percent Change Therms Consumed	Percent Change Total Cost	Percent Change Dollars Per Therm
Fuel oil, total	686[b]	643,510	51,092	.079	624[b]	528,251	114,059	.216	- 9.0	-17.9	123.2	173.4
#6 Fuel oil	328	461,530	33,406	.072	270	370,700	78,172	.211	-17.7	-19.7	134.0	193.1
#5 Fuel oil	75	26,440	2,052	.078	58	19,588	4,436	.226	-22.7	-25.9	116.2	189.7
#4 Fuel oil	156	40,395	3,515	.087	116	24,072	5,116	.213	-25.6	-40.4	45.5	144.8
#2 Fuel oil	527	115,145	12,119	.105	500	113,891	26,335	.231	- 5.1	- 1.1	117.3	120.0
Natural gas	310	54,987	4,887	.089	266	41,245	6,024	.146	-14.2	-24.9	23.3	64.0
Coal	9	4,927	283	.057	4	8,978	974	.108	-55.6	82.2	244.2	89.5
Purchased electricity	655	153,838	74,616	.485	595	143,502	116,585	.812	- 9.2	- 6.7	56.2	67.4
Purchased steam	8	2,157	568	.263	8	1,816	1,026	.565	0	-15.8	80.6	114.8
Propane	22	365	59	.162	39	430	136	.316	77.3	17.8	130.5	95.1
Other	0	--	--	--	0	--	--	--	--	--	--	--
Total	686	859,684	131,505	.153	624	724,222	238,804	.330	- 9.0	-15.8	81.6	115.7

[a] Primary fuel is defined as that fuel upon which an institution was most dependent, in terms of the total number of therms consumed.

[b] Unduplicated total of institutions using oil.

NOTE: Only the three major fuel types are tabulated in the primary fuel series. Therefore, the numbers of institutions do not add to the total population.

Table A-9

Fuel Consumption and Cost: Institutions Whose Primary Fuel[a] Is Natural Gas

Type of Fuel	1972-73 N	1972-73 Therms Consumed (in thousands)	1972-73 Total Cost (in thousands)	1972-73 Dollars Per Therm	1974-75 N	1974-75 Therms Consumed (in thousands)	1974-75 Total Cost (in thousands)	1974-75 Dollars Per Therm	Percent Change N	Percent Change Therms Consumed	Percent Change Total Cost	Percent Change Dollars Per Therm
Fuel oil, total	747[b]	164,957	15,052	.091	699[b]	98,522	21,024	.213	- 6.4	-40.3	39.7	134.1
#6 Fuel oil	75	78,289	6,826	.087	69	41,244	8,628	.209	- 8.0	-47.3	26.4	140.2
#5 Fuel oil	100	21,051	1,905	.090	91	15,220	3,226	.212	- 9.0	-27.7	69.3	135.6
#4 Fuel oil	19	2,998	264	.088	17	2,942	665	.226	-10.5	- 1.9	151.9	156.8
#2 Fuel oil	610	62,619	6,057	.097	579	39,136	8,505	.217	- 5.1	-37.5	40.4	123.7
Natural gas	1700	1,654,495	89,699	.054	1587	1,504,236	131,835	.088	- 6.6	- 9.1	47.0	63.0
Coal	40	38,533	1,995	.052	53	41,428	5,109	.123	32.5	7.5	156.1	136.5
Purchased electricity	1657	430,426	159,007	.369	1548	417,041	229,059	.549	- 6.6	- 3.1	44.1	48.8
Purchased steam	11	8,818	1,045	.119	11	10,916	1,812	.166	0	23.8	73.4	39.5
Propane	29	638	93	.146	31	788	262	.332	6.9	23.5	181.7	127.4
Other	0	--	--	--	0	--	--	--	--	--	--	--
Total	1700	2,297,867	266,891	.116	1587	2,072,931	389,101	.188	- 6.6	- 9.8	45.8	62.1

[a] Primary fuel is defined as that fuel upon which an institution was most dependent, in terms of the total number of therms consumed.

[b] Unduplicated total of institutions using oil.

NOTE: Only the three major fuel types are tabulated in the primary fuel series. Therefore, the numbers of institutions do not add to the total population.

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Table A-10

Fuel Consumption and Cost: Institutions Whose Primary Fuel[a] is Coal

Type of Fuel	1972-73 N	1972-73 Therms Consumed (in thousands)	1972-73 Total Cost (in thousands)	1972-73 Dollars Per Therm	1974-75 N	1974-75 Therms Consumed (in thousands)	1974-75 Total Cost (in thousands)	1974-75 Dollars Per Therm	Percent Change N	Percent Change Therms Consumed	Percent Change Total Cost	Percent Change Dollars Per Therm
Fuel oil, total	25[b]	24,754	2,009	.081	26[b]	23,967	5,154	.215	4.0	- 3.2	156.5	165.4
#6 Fuel oil	13	19,464	1,513	.078	13	21,289	4,604	.216	0	9.4	204.3	176.9
#5 Fuel oil	3	2,027	144	.071	2	116	26	.224	-33.3	-94.3	-81.9	215.5
#4 Fuel oil	0	--	--	--	1	8	2	.250	--	--	--	--
#2 Fuel oil	17	3,263	352	.108	18	2,554	522	.204	5.9	-21.7	48.3	88.9
Natural gas	59	54,770	3,470	.063	59	50,557	4,882	.097	0	- 7.7	40.7	54.0
Coal	95	346,175	18,661	.054	91	337,810	41,899	.124	- 4.2	- 2.4	124.5	129.6
Purchased electricity	83	76,340	27,057	.354	79	71,318	39,461	.553	- 4.8	- 6.6	45.8	56.2
Purchased steam	1	365	57	.156	1	2,183	740	.339	0	498.1	198.2	117.3
Propane	1	9	3	.333	1	8	3	.375	0	-11.1	--	12.6
Other	3	145	166	1.145	0	--	--	--	-100.0	-100.0	-100.0	-100.0
Total	95	502,558	51,423	.102	91	485,843	92,139	.190	- 4.2	- 3.3	79.2	86.3

[a] Primary fuel is defined as that fuel upon which an institution was most dependent, in terms of the total number of therms consumed.

[b] Unduplicated total of institutions using oil.

NOTE: Only the three major fuel types are tabulated in the primary fuel series. Therefore, the numbers of institutions do not add to the total population.

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Table A-11

Fuel Consumption and Cost: Doctoral and Comprehensive Institutions

Type of Fuel	1972-73 N	1972-73 Therms Consumed (in thousands)	1972-73 Total Cost (in thousands)	1972-73 Dollars Per Therm	1974-75 N	1974-75 Therms Consumed (in thousands)	1974-75 Total Cost (in thousands)	1974-75 Dollars Per Therm	Percent Change N	Percent Change Therms Consumed	Percent Change Total Cost	Percent Change Dollars Per Therm
Fuel oil, total	149[a]	348,466	26,747	.077	135[a]	286,373	60,744	.212	- 9.4	-17.8	127.1	175.3
#6 Fuel oil	75	253,987	18,352	.072	66	217,458	46,833	.215	-12.0	-14.4	155.2	198.6
#5 Fuel oil	22	9,761	796	.082	15	4,520	995	.220	-31.8	-53.7	25.0	168.3
#4 Fuel oil	20	8,056	797	.099	19	6,292	1,490	.237	- 5.0	-21.9	87.0	139.4
#2 Fuel oil	92	76,662	6,802	.089	91	58,103	11,431	.197	- 1.1	-24.2	68.1	121.3
Natural gas	180	836,152	41,946	.050	175	804,827	71,759	.089	- 2.8	- 3.7	71.1	78.0
Coal	50	295,598	16,174	.055	46	268,129	31,633	.118	- 8.0	- 9.3	95.6	114.5
Purchased electricity	203	363,279	129,948	.358	191	350,454	203,078	.579	- 5.9	- 3.5	56.3	61.7
Purchased steam	27	64,330	11,821	.184	28	87,906	23,980	.273	3.7	36.6	102.9	48.4
Propane	9	392	62	.158	8	509	177	.348	-11.1	29.8	185.5	120.3
Other	10	24,561	1,321	.054	6	34,135	3,152	.092	-40.0	39.0	138.5	70.4
Total	208	1,932,778	228,019	.118	195	1,832,333	394,528	.215	- 6.3	- 5.2	73.0	82.2

[a]Unduplicated total of institutions using oil.

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Table A-12
Fuel Consumption and Cost: Other Four-Year Colleges

Type of Fuel	1972-73 N	1972-73 Therms Consumed (in thousands)	1972-73 Total Cost (in thousands)	1972-73 Dollars Per Therm	1974-75 N	1974-75 Therms Consumed (in thousands)	1974-75 Total Cost (in thousands)	1974-75 Dollars Per Therm	Percent Change N	Percent Change Therms Consumed	Percent Change Total Cost	Percent Change Dollars Per Therm
Fuel oil, total	1006[a]	480,769	38,932	.081	1000[a]	419,145	89,975	.215	- .6	-12.8	131.1	165.4
#6 Fuel oil	306	324,808	24,172	.074	319	276,348	57,637	.209	4.2	-14.9	138.4	182.4
#5 Fuel oil	161	40,838	3,267	.080	132	30,971	6,825	.220	-18.0	-24.2	108.9	175.0
#4 Fuel oil	134	31,313	2,779	.089	131	25,381	5,897	.232	- 2.2	-18.9	112.2	160.7
#2 Fuel oil	740	83,810	8,714	.104	744	86,445	19,616	.227	.5	3.1	125.1	118.3
Natural gas	1358	774,206	47,674	.062	1378	782,237	71,282	.091	1.5	1.0	49.5	46.8
Coal	135	177,795	9,946	.056	125	160,602	21,466	.134	- 7.4	- 9.7	115.8	139.3
Purchased electricity	1587	356,263	140,353	.394	1615	366,873	227,894	.621	1.8	3.0	62.4	57.6
Purchased steam	34	12,349	2,646	.214	41	15,454	5,793	.375	20.6	25.1	118.9	75.2
Propane	47	624	94	.151	51	771	241	.313	8.5	23.6	156.4	107.3
Other	7	324	20	.062	8	78	12	.154	14.3	-75.9	-40.0	148.4
Total	1650	1,802,330	239,665	.133	1665	1,745,160	416,663	.239	.9	- 3.2	73.9	79.7

[a]Unduplicated total of institutions using oil.

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Table A-13

Fuel Consumption and Cost: Two-Year Colleges and Institutes

Type of Fuel	1972-73 N	1972-73 Therms Consumed (in thousands)	1972-73 Total Cost (in thousands)	1972-73 Dollars Per Therm	1974-75 N	1974-75 Therms Consumed (in thousands)	1974-75 Total Cost (in thousands)	1974-75 Dollars Per Therm	Percent Change N	Percent Change Therms Consumed	Percent Change Total Cost	Percent Change Dollars Per Therm
Fuel oil, total	548[a]	94,339	9,739	.103	557[a]	83,491	20,088	.241	1.6	-11.5	106.3	134.0
#6 Fuel oil	85	40,179	3,572	.089	73	31,771	6,809	.214	-14.1	-20.9	90.6	140.4
#5 Fuel oil	11	914	172	.188	24	1,605	316	.197	118.2	75.6	83.7	4.8
#4 Fuel oil	84	16,537	1,313	.079	89	15,505	3,231	.208	6.0	- 6.2	146.1	163.3
#2 Fuel oil	523	36,709	4,682	.128	537	34,610	9,732	.281	2.7	- 5.7	107.9	119.5
Natural gas	804	294,312	17,343	.059	796	220,814	22,529	.102	- 1.0	-25.0	29.9	72.9
Coal	48	753	70	.093	65	1,104	148	.134	35.4	46.6	111.4	44.1
Purchased electricity	1054	122,574	59,767	.488	1059	128,514	89,503	.696	.5	4.8	49.8	42.6
Purchased steam	0	--	--	--	16	1,981	403	.203	--	--	--	--
Propane	0	--	--	--	16	18	7	.389	--	--	--	--
Other	17	2,329	203	.087	0	--	--	--	-100.0	-100.0	-100.0	-100.0
Total	1124	514,307	87,122	.169	1124	435,922	132,678	.304	0	-15.2	52.3	79.9

[a]Unduplicated total of institutions using oil.

Table A-14

Fuel Costs per Square Foot, by Selected Institutional Characteristics

Institutional Characteristics	1972-73 N	1972-73 Square Feet (in thousands)	1972-73 Total Cost (in thousands)	1972-73 Dollars per Square Foot	1974-75 N	1974-75 Square Feet (in thousands)	1974-75 Total Cost (in thousands)	1974-75 Dollars per Square Foot	Percent Change N	Percent Change Dollars per Square Foot
Total	2982	2,010,900	554,806	.276	2984	2,174,961	943,869	.434	.1	57.2
Census Region										
East	786	532,293	169,019	.318	784	570,129	328,426	.576	- .3	81.1
Midwest	815	519,755	157,220	.302	814	564,363	233,199	.413	- .1	36.8
South	923	601,856	141,887	.236	922	655,204	260,806	.398	- .1	68.6
West	458	356,996	86,680	.243	464	385,265	121,438	.315	1.3	29.6
Primary Fuel[a]										
Oil	686	418,146	131,505	.314	624	423,471	238,804	.564	-9.0	79.6
Natural gas	1700	992,017	266,891	.269	1587	1,056,415	389,101	.368	-6.6	36.8
Coal	95	207,994	51,423	.247	91	219,590	92,139	.420	-4.2	70.0
Type										
Doctoral and comprehensive	208	763,602	228,019	.299	195	803,033	394,528	.491	-6.3	64.2
Other four-year	1650	965,794	239,665	.248	1665	1,048,436	416,663	.397	.9	60.1
Two-year	1124	281,504	87,122	.309	1124	323,492	132,678	.410	0	32.7

[a]Only the three major fuel types are tabulated in the primary fuel series. Therefore, the numbers of institutions do not add to the total population.

NEW

Table A-15
Fuel Consumption per Square Foot, by Selected Institutional Characteristics

Institutional Characteristics	1972-73 N	1972-73 Square Feet (in thousands)	1972-73 Total Therms (in thousands)	1972-73 Therms per Square Foot	1974-75 N	1974-75 Square Feet (in thousands)	1974-75 Total Therms (in thousands)	1974-75 Therms per Square Foot	Percent Change N	Percent Change Therms per Square Foot
Total	2982	2,010,900	4,249,415	2.11	2984	2,174,961	4,013,415	1.85	.1	-12.3
Census Region										
East	786	532,293	1,022,334	1.92	784	570,129	990,636	1.74	- .3	- 9.4
Midwest	815	519,755	1,265,746	2.44	814	564,363	1,190,575	2.11	- .1	-13.5
South	923	601,856	1,221,858	2.03	922	655,204	1,139,446	1.74	- .1	-14.3
West	458	356,996	739,477	2.07	464	385,265	692,758	1.80	1.3	-13.0
Primary Fuel[a]										
Oil	686	418,146	859,684	2.06	624	423,471	724,222	1.71	-9.0	-17.0
Natural gas	1700	992,017	2,297,867	2.32	1587	1,056,415	2,072,931	1.96	-6.6	-16.5
Coal	95	207,994	502,558	2.42	91	219,590	485,843	2.21	-4.2	- 8.7
Type										
Doctoral and Comprehensive	208	763,602	1,932,778	2.53	195	803,033	1,832,333	2.28	-6.3	- 9.9
Other four-year	1650	965,794	1,802,330	1.87	1665	1,048,436	1,745,160	1.66	.9	-11.2
Two-year	1124	281,504	514,307	1.83	1124	323,492	435,922	1.35	0	-26.2

[a]Only the three major fuel types are tabulated in the primary fuel series. Therefore, the numbers of institutions do not add to the total population.

NOW

Table A-16

Fuel Costs per Student (Full-Time Equivalent), by Selected Institutional Characteristics

Institutional Characteristics	1972-73 N	1972-73 FTE Enrollment (in thousands)	1972-73 Total Cost (in thousands)	1972-73 Dollars per Student	1974-75 N	1974-75 FTE Enrollment (in thousands)	1974-75 Total Cost (in thousands)	1974-75 Dollars per Student	Percent Change N	Percent Change Dollars per Student
Total	2982	7,029	554,806	78.931	2984	7,612	943,869	123.998	.1	57.1
Census Region										
East	786	1,635	169,019	103.376	784	1,783	328,426	184.199	- .3	78.2
Midwest	815	1,891	157,320	83.141	814	1,963	233,199	118.797	- .1	42.9
South	923	1,974	141,887	71.878	922	2,156	260,806	120.968	- .1	68.3
West	458	1,529	86,680	56.691	464	1,710	121,438	71.016	1.3	25.3
Primary Fuel[a]										
Oil	686	1,114	131,505	118.048	624	1,229	238,804	194.308	-9.0	64.6
Natural gas	1700	3,392	266,891	78.682	1587	3,619	389,101	107.516	-6.6	36.6
Coal	95	588	51,423	87.454	91	610	92,139	151.048	-4.2	72.7
Type										
Doctoral and comprehensive	208	2,337	228,019	97.569	195	2,429	394,528	162.424	-6.3	66.5
Other four-year	1650	2,929	239,665	81.825	1665	3,064	416,663	135.987	.9	66.2
Two-year	1124	1,763	87,122	49.417	1124	2,119	132,678	62.613	0	26.7

[a]Only the three major fuel types are tabulated in the primary fuel series. Therefore, the numbers of institutions do not add to the total population.

NEW

52

Table A-17

Fuel Consumption per Student (Full-Time Equivalent), by Selected Institutional Characteristics

Institutional Characteristics	1972-73 N	1972-73 FTE Enrollment (in thousands)	1972-73 Total Therms (in thousands)	1972-73 Therms per Student	1974-75 N	1974-75 FTE Enrollment (in thousands)	1974-75 Total Therms (in thousands)	1974-75 Therms per Student	Percent Change N	Percent Change Therms per Student
Total	2982	7,029	4,249,415	604.55	2984	7,612	4,013,415	527.25	.1	-12.8
Census Region										
East	786	1,635	1,022,334	625.28	784	1,783	990,636	555.60	- .3	-11.1
Midwest	815	1,891	1,265,746	669.35	814	1,963	1,190,575	606.51	- .1	- 9.4
South	923	1,974	1,221,858	618.98	922	2,156	1,139,446	528.50	- .1	-14.6
West	458	1,529	739,47	483.63	464	1,710	692,758	405.12	1.3	-16.2
Primary Fuel[a]										
Oil	686	1,114	859,684	771.71	624	1,229	724,222	589.28	-9.0	-23.6
Natural gas	1700	3,392	2,297,867	677.44	1587	3,619	2,072,931	572.79	-6.6	-15.4
Coal	95	588	502,558	854.69	91	610	485,843	796.46	-4.2	- 6.8
Type										
Doctoral and comprehensive	208	2,337	1,932,778	827.02	195	2,429	1,832,333	754.36	-6.3	- 8.8
Other four-year	1650	2,929	1,802,330	615.34	1665	3,064	1,745,160	569.57	.9	- 7.4
Two-year	1124	1,763	514,307	291.72	1124	2,119	435,922	205.72	0	-29.5

[a]Only the three major fuel types are tabulated in the primary fuel series. Therefore, the numbers of institutions do not add to the total population.

Table A-18
Percent of Institutions Implementing Quick Fix Measures, by Selected Characteristics

Quick Fix Measures	Total (N=533)	Census Region				Primary Fuel[a]			Type of Institution		
		East (N=148)	Midwest (N=150)	South (N=101)	West (N=74)	Oil (N=128)	Natural Gas (N=291)	Coal (N=34)	Doctoral and Comprehensive (N=158)	Other Four-Year (N=302)	Two-Year (N=73)
Setting specific temperature ranges											
65°-68°F winter	84.8	92.5	88.4	77.2	78.4	91.3	81.8	94.1	86.6	85.9	76.1
75°-80°F summer	85.4	94.3	84.8	81.1	78.3	90.8	81.6	91.2	87.3	85.8	79.1
Reducing illumination levels	86.8	89.0	85.3	84.4	90.4	90.4	84.2	94.1	93.6	84.3	81.9
Closing down buildings during nights & weekends	73.0	74.8	67.1	76.1	74.3	76.4	71.0	63.6	78.3	68.9	78.1
Consolidating activities into fewer buildings	34.2	32.9	31.8	40.6	27.4	39.7	31.3	24.2	29.7	32.8	49.3
Developing efficient space allocation practices	20.9	24.3	18.7	21.4	17.6	28.2	18.3	8.8	20.3	20.1	25.4
Scheduling vacations during energy-intensive periods	27.1	40.7	24.2	23.3	14.9	37.6	22.4	26.5	19.7	31.9	23.6
Restricting appliance usage	25.2	32.0	20.1	26.3	19.4	33.3	19.9	33.3	27.2	26.2	16.7
Restricting air conditioning installation	47.3	58.9	45.6	40.3	43.5	62.7	41.1	51.5	51.9	47.3	36.4
Reducing domestic hot water temperature	66.2	79.1	59.7	58.4	70.3	79.7	59.0	70.6	79.1	62.5	53.4
Manually reducing fresh air makeup	70.1	79.6	73.5	57.2	72.2	80.3	68.3	61.8	77.6	71.0	49.3
Manually monitoring buildings	75.7	85.0	78.2	71.1	61.6	83.2	72.9	70.6	74.4	75.6	78.9
Adjusting schedules to maximize daylight hours	25.3	22.4	25.5	27.5	25.7	24.6	25.5	23.5	24.2	24.7	30.1
Installing blinds and drapes to reduce heat leakage	38.2	38.6	32.0	47.5	30.1	39.5	36.6	35.3	28.2	41.3	47.2
Reviewing current energy systems											
Inspecting steam traps	81.5	81.8	87.9	80.5	70.4	84.9	79.3	94.1	79.9	86.5	64.2
Inspecting valve functions and air filtration systems	89.3	89.2	90.6	90.1	85.1	92.2	88.0	94.1	88.0	90.0	89.0
Conducting ORSAT analysis of flue gasses	40.8	44.3	46.9	30.5	43.8	45.5	43.1	38.2	54.5	37.4	23.9
Involving the institutional community											
Establishing a faculty-staff-student energy committee	34.2	40.1	34.9	28.9	32.4	31.2	34.1	38.2	45.9	30.4	24.7
Appointing building energy monitors	20.4	28.9	17.4	19.4	12.2	24.6	16.6	20.6	25.9	18.7	15.1
Holding energy briefing sessions	30.6	35.1	26.2	32.1	27.0	36.5	27.2	32.4	25.3	32.4	34.2
Having campus-wide energy awareness programs	65.5	68.2	62.2	65.6	66.2	77.2	61.2	55.9	70.9	63.2	63.0
Conserving water											
Resetting automatic flush valves	41.3	41.3	44.6	40.6	35.6	43.0	38.7	41.2	38.5	42.4	43.1
Fixing minor water leaks	93.4	92.6	98.8	91.2	90.5	94.5	92.1	91.2	92.4	94.7	90.4

[a] Primary fuel is that fuel upon which an institution was most dependent, in terms of the total number of therms consumed, in 1974-75.

NOTE: Data are unweighted. The number of respondents varies from item to item.

Table A-19

Percent of Institutions Implementing Refit Measures[a], by Selected Characteristics

Refit Measures	Total (N=530)	Census Region: East (N=145)	Midwest (N=150)	South (N=160)	West (N=74)	Primary Fuel[b]: Oil (N=127)	Natural Gas (N=291)	Coal (N=34)	Type of Institution: Doctoral and Comprehensive (N=157)	Other Four-Year (N=301)	Two-Year (N=72)
Conducting energy technical studies											
Classifying buildings by function, energy consumption, etc.	34.4	39.7	29.9	36.1	28.8	41.3	29.8	29.4	47.7	29.5	25.4
Reviewing existing systems to identify capital investment options	57.1	69.9	51.7	51.6	54.1	66.7	49.8	54.5	68.8	54.2	43.1
Identifying heat loss by infrared photography	4.7	8.8	6.1	1.2	1.4	8.7	2.4	11.8	11.4	2.3	0
Analyzing electrical rate structures, power factors, etc.	67.0	73.8	62.8	61.0	75.0	68.8	64.1	64.7	84.0	60.7	55.7
Modifying lighting systems											
Converting from incandescent to fluorescent fixtures	78.8	81.5	75.8	76.9	83.6	78.7	77.5	88.2	80.1	79.3	74.0
Utilizing time clocks on lighting systems	72.5	78.8	70.5	67.5	75.3	74.0	70.2	60.6	71.2	72.9	74.0
Revising circuitry to reduce overlighting	50.2	52.7	51.4	43.8	56.8	49.6	47.9	55.9	61.5	45.3	45.8
Using task vs. area lighting	33.4	34.5	32.0	31.6	38.0	32.5	33.0	31.2	48.4	26.9	27.1
Reducing heating and air conditioning system losses											
Increasing steam-line insulation	53.7	53.8	51.0	55.0	56.2	53.6	52.8	67.6	60.0	53.8	39.4
Insulating roofs and walls	47.2	49.0	44.0	49.1	45.9	45.2	47.8	35.3	40.1	48.8	55.6
Utilizing weatherstripping, storm windows, etc.	60.3	71.0	59.5	58.8	44.6	65.1	58.2	71.9	60.9	62.0	52.1
Refining HVAC control systems											
Rezoning heating/cooling systems	32.7	42.4	31.2	33.1	15.5	43.7	26.3	41.9	33.3	32.1	34.3
Installing timers on exhaust and air handling systems	57.6	60.2	59.9	49.7	64.9	57.6	56.7	66.7	69.6	53.7	47.2
Installing variable speed drives	22.2	21.5	25.9	20.9	18.9	18.5	22.5	24.2	23.6	21.8	20.8
Installing motorized steam valves	52.0	59.6	50.0	44.9	56.2	59.7	48.1	45.5	65.0	49.7	33.3
Automatically reducing fresh air makeup	53.9	56.2	57.4	45.2	60.8	51.6	52.2	60.6	59.5	52.2	48.6
Centralizing monitoring of buildings	29.1	24.3	31.1	27.7	37.8	23.0	29.0	41.2	53.8	16.2	28.2
Conserving water											
Installing solenoid valves	36.9	37.3	31.9	40.0	39.4	33.3	36.7	46.9	48.4	32.7	28.4
Installing flow restrictors	52.7	61.8	53.5	46.7	45.1	63.1	49.5	54.5	62.1	54.4	24.6

[a] Includes institutions that responded "partially completed, not practical to do more," "partially completed, would like to do more," and "completed."

[b] Primary fuel is that fuel upon which an institution was most dependent, in terms of the total number of therms consumed, in 1974-75.

NOTE: Data are unweighted. The number of respondents varies from item to item.

Table A-20

Percent of Institutions Implementing Systems Convert Measures[a], by Selected Characteristics

Systems Convert Measures	Total (N=527)	Census Region: East (N=145)	Midwest (N=149)	South (N=159)	West (N=74)	Primary Fuel[b]: Oil (N=126)	Natural Gas (N=290)	Coal (N=34)	Type of Institution: Doctoral and Comprehensive (N=157)	Other Four-Year (N=298)	Two-Year (N=72)
Installing computerized building monitoring systems	20.5	14.1	23.9	21.8	23.9	16.5	20.7	26.5	44.8	9.7	11.8
Installing central computerized controls	22.5	16.7	25.9	21.7	29.6	17.9	23.6	29.4	47.1	12.3	10.4
Converting building systems											
Introducing solar energy systems	.8	.7	0	1.3	1.4	0	.7	0	.6	1.0	0
Installing independently zoned environment controls for specialized space	38.3	37.9	40.8	34.6	41.9	38.4	37.8	38.2	49.7	32.0	39.4
Rewiring major electrical systems to minimize demand charges & avoid establishing new peaks	29.2	26.2	37.6	27.0	23.0	29.0	29.0	20.6	27.4	30.9	26.4
Converting from dual duct to variable volume air systems	10.5	7.8	14.6	10.2	8.1	9.8	11.5	9.4	10.2	10.4	11.4
Altering reheat systems	17.2	17.0	17.8	16.6	17.8	15.6	17.3	14.7	24.0	13.1	19.4
Upgrading primary boiler and chiller plants											
Converting to alternate fuel sources	35.2	26.9	42.2	30.8	47.3	27.6	40.1	47.1	44.3	32.9	25.0
Automating power plants	43.3	43.8	51.7	35.8	41.9	46.7	43.6	55.9	52.2	39.9	37.5
Utilizing solid waste recovery fuel systems	.8	.7	1.4	0	1.4	0	1.0	0	1.9	.3	0
Installing waste heat recovery systems	13.6	11.8	14.5	12.6	17.6	9.7	13.2	26.5	23.7	7.8	15.3

[a] Includes institutions that responded "partially completed, not practical to do more," "partially completed, would like to do more," and "completed."

[b] Primary fuel is that fuel upon which an institution was most dependent, in terms of the total number of therms consumed, in 1974-75.

NOTE: Data are unweighted. The number of respondents varies from item to item.

Table A-21
Percent of Institutions Reporting Various Experiences, by Selected Characteristics

Experiences	Total (N=533)	Census Region: East (N=149)	Midwest (N=149)	South (N=162)	West (N=74)	Primary Fuel[a]: Oil (N=128)	Natural Gas (N=291)	Coal (N=34)	Type of Institution: Doctoral and Comprehensive (N=158)	Other Four-Year (N=303)	Two-Year (N=72)
Has issued official policy statement on conservation	81.6	87.2	75.2	85.0	75.7	87.5	78.4	81.8	85.4	79.9	80.6
Has capacity to burn a variety of fuel	48.5	37.2	58.1	46.9	55.4	40.9	54.8	57.1	63.7	44.5	31.9
Has experienced difficulty obtaining fuel	12.0	9.5	14.2	11.7	13.5	8.6	13.1	14.3	14.6	11.6	8.3
Is now experiencing difficulty obtaining fuel	4.3	3.4	3.4	6.2	4.1	1.6	6.2	5.9	4.5	4.0	5.6
Has examined federal allocation policies	53.6	59.7	49.0	48.1	62.2	58.7	54.0	48.5	61.3	50.2	50.0
Holds interruptible gas contract	49.2	30.8	65.1	48.4	55.4	30.6	59.3	48.6	58.9	48.0	32.9
Experienced curtailment during 1974-75[b]	(43.7)	(39.1)	(51.0)	(41.0)	(36.6)	(64.1)	(41.5)	(38.9)	(44.7)	(47.6)	(13.6)
Expects curtailment during 1975-76[b]	(51.0)	(41.3)	(55.2)	(55.1)	(43.9)	(56.4)	(49.7)	(61.1)	(52.6)	(52.1)	(34.8)
Has not been allowed to burn specific fuels because of federal, state, or local standards	18.9	34.2	11.2	11.9	20.5	34.9	10.6	22.9	32.7	15.4	2.9

[a] Primary fuel is that fuel upon which an institution was most dependent, in terms of the total number of therms consumed, in 1974-75.

[b] Based upon institutions which hold interruptible gas contracts.

NOTE: Data are unweighted. The number of respondents varies from item to item.

Appendix B: Survey Instrument

AMERICAN COUNCIL ON EDUCATION
ONE DUPONT CIRCLE
WASHINGTON, D. C. 20036

OFFICE OF THE PRESIDENT

February 6, 1976

Dear Colleague:

As you know, there has been much discussion about the impact of escalating energy costs upon institutions of higher education. In an effort to assess more accurately the institutional impact and response to the energy dilemma, we must develop a solid base of information about these energy cost increases and the conservation practices being devised to contain them.

Initiated at the request of the U.S. Office of Education, the attached survey has been developed in consultation with the Federal Energy Administration and the Energy Task Force -- a group sponsored by the American Council on Education, the National Association of College and University Business Officers, and the Association of Physical Plant Administrators of Universities and Colleges. Such collective sponsorship will eliminate the need for redundant energy related inquiries from these groups.

Given the importance of the energy issue and the need for accurate information, I urge you to review this questionnaire and to assign its completion to the appropriate officer at your institution. Individual institutions will not be identified in reports of results, copies of which will be sent to participants of the survey.

The successful accumulation and dissemination of such energy information will be of significant benefit to us all. We are grateful for your assistance.

Sincerely yours,

Roger W. Heyns

Roger W. Heyns

AMERICAN COUNCIL ON EDUCATION
ONE DUPONT CIRCLE
WASHINGTON, D. C. 20036

HIGHER EDUCATION PANEL

February 6, 1976

Dear HEP Representative:

I am writing to tell you about a special Higher Education Panel survey being conducted by the American Council on Education on energy costs and conservation. The survey is being sponsored by several organizations which recognize the importance of this first-time effort to compile meaningful energy data. They include the U.S. Office of Education, the Federal Energy Administration, and the Energy Task Force, a group sponsored by the American Council on Education, the National Association of College and University Business Officers and the Association of Physical Plant Administrators of Universities and Colleges. Since the survey questionnaire has been mailed to the President of your institution for assignment of responsibility, we are neither sending it directly to you nor asking you to assume responsibility for its completion. However, since the survey will be circulating on your campus in February, we thought you might be interested in knowing its origin and purpose.

The survey is titled "Impact of Energy Cost Increases and Energy Conservation Programs at Colleges and Universities," and is designed to create a sound base of information regarding institutional energy costs and conservation efforts. Needless to say, success in gathering this information will be very important to the higher education community. If you do become involved with the survey in some way we trust you will help it on its way to completion.

Once more, we express our thanks to you for your continued cooperation.

Sincerely,

Frank Atelsek

Frank Atelsek, Director

IMPACT OF ENERGY COST
INCREASES AND ENERGY CONSERVATION PROGRAMS AT
COLLEGES AND UNIVERSITIES

The impact of rising energy costs upon institutional budgets is a matter of great concern to higher education. Faced with escalating prices and fewer resources, many institutions have developed and implemented conservation programs which have resulted in significant energy savings.

This survey, conducted through the Higher Education Panel of the American Council on Education, in consultation with the Federal Energy Administration, has been developed jointly by the U.S. Office of Education and the Energy Task Force - a group sponsored by the American Council on Education, the Association of Physical Plant Administrators of Universities and Colleges, and the National Association of College and University Business Officers. The survey's purpose is to establish a definitive data base on energy costs and consumption trends at colleges and universities as well as to assess the range of energy conservation practices and plans throughout higher education. Such data are essential for evaluating the reaction of colleges and universities to the rapid changes in the cost and availability of energy and for identifying ways to assist institutions in their conservation efforts. The collective sponsorship represented by this survey will also eliminate the need for redundant energy surveys.

Please return the completed questionnaire in the attached prepaid envelope by March 1, 1976 to:

American Council on Education
Higher Education Panel
One Dupont Circle, N.W.
Washington, D.C. 20036

If you have any questions please do not hesitate to call the Panel staff (collect), at (202) 833-4757.

We thank you for your assistance.

INSTRUCTIONS AND DEFINITIONS

Section I: Please provide the information requested regarding the amount and total cost of fuel consumed for each fiscal year. *Please note that the two fiscal years are not consecutive -- 1973-74 has been omitted.*

bbl - barrel, containing 42 gallons (oil)
mcf - thousands of cubic feet (natural gas)
kwh - kilowatt hours (purchased electricity)
lbs - pounds (purchased steam)

Current fund expenditures - Costs incurred for goods and services used in the conduct of institutional operations within one year, including Educational and General, Auxiliary Enterprises, Hospitals, Independent Operations. (See "Administrative Services Handbook," National Association of College and University Business Officers, for a complete definition.)

BTU - British thermal unit, the quantity of heat required to raise the temperature of one pound of water one degree Fahrenheit at or near 39.2°F. *The BTU content per unit of fuel can be obtained from your fuel supplier.*

HVAC - heating, ventilating, and air conditioning

Section II: For each of the three phases of conservation measures, use the appropriate numerical code to indicate the extent of your institution's involvement in each measure. For example:

	B. REFIT	*Code:* 1 = Not done, not applicable; 2 = Not done, would like to do; 3 = Partially completed, not practical to do more; 4 = Partially completed, would like to do more; 5 = Completed
[redacted]	*Modification of lighting system*	
4	Conversion from incandescent to fluorescent...	
2	Utilization of timeclocks on lighting systems	
1	Revision of light switch circuitry to reduce overlighting	
	. . .	

HVAC - heating, ventilating, and air conditioning

Section III: Please check "yes" or "no" as appropriate.

IF YOU HAVE ANY QUESTIONS, PLEASE CALL THE HIGHER EDUCATION PANEL STAFF (COLLECT) AT (202) 833-4757.

OMB#99-0265 Ex. 6/76

American Council on Education
Higher Education Panel Survey No. 31

IMPACT OF ENERGY COST INCREASES AND ENERGY CONSERVATION PROGRAMS AT COLLEGES AND UNIVERSITIES

1. *Fuel Cost and Consumption.* Include fuel necessary to maintain only buildings and facilities; do not include transportation fuel needs.

Type of Fuel	*1973-74 (FY)* Amount of Fuel Consumed	*1973-74 (FY)* Total Cost of Fuel	*1974-75 (FY)* Amount of Fuel Consumed	*1974-75 (FY)* Total Cost of Fuel
No. 6 Fuel Oil	bbls	$	bbls	$
No. 5 Fuel Oil	bbls	$	bbls	$
No. 4 Fuel Oil	bbls	$	bbls	$
No. 2 Fuel Oil	bbls	$	bbls	$
Natural Gas	mcf	$	mcf	$
Coal	tons	$	tons	$
Purchased Electricity	kwh	$	kwh	$
Purchased Steam	lbs	$	lbs	$
Other: (specify)		$		$
TOTAL		$		$
Total as a % of Current Fund Expenditures		%		%

	1973-74 (FY)	*1974-75 (FY)*
IF YOU USE COAL: What is its BTU content per ton?	_____ BTU per ton	_____ BTU per ton
IF YOU USE NO.6 FUEL: What is its BTU content per bbl?	_____ BTU per bbl	_____ BTU per bbl
Gross number of sq. ft. serviced by fuel reported above	_____ sq. ft.	_____ sq. ft.
WITHIN STATED YEAR ONLY: What best describes the energy conservation program at your institution?	☐ None ☐ Minimal ☐ Moderate ☐ Extensive	☐ None ☐ Minimal ☐ Moderate ☐ Extensive
WITHIN STATED YEAR ONLY: What do you estimate to be the percentage reduction in energy consumption as a result?	_____ %	_____ %

11. *Capital Investments for Energy Conservation.*

Review of higher education's institutional energy conservation programs discloses a three phase pattern of building investment programs which affords energy consumption reduction opportunities at varying levels of expenditure. The three phases may be classified as QUICK FIX, REFIT, and SYSTEMS CONVERT. Such pattern, phased over a period of years, will ensure investment in the most attractive energy conservation options at a pace that will neither outstrip emerging energy technology nor an institution's technical capacity to wisely invest available funds.

A. QUICK FIX: Basic, essentially nontechnical energy conservation measures requiring minimal lead time and negligible capital expense

B. REFIT: Development of technical studies, and implementation of other measures requiring a modest outlay of capital

C. SYSTEMS CONVERT: Sophisticated, technical energy conservation measures requiring substantial capital expenditures

The following are representative lists of energy conservation options divided into the QUICK FIX, REFIT and SYSTEMS CONVERT phases. *Please use the appropriate code to indicate the extent of your institution's involvement in each option listed below:*

	A. QUICK FIX. *Code:* 1 = No (no considerable involvement in this activity) 2 = Yes (considerable involvement in this activity)
	Control of temperature ranges and thermostat settings:
	65° - 68°F Winter
	75° - 80°F Summer
	Reduction in illumination levels and lamp wattage
	Substantial night and weekend building shutdowns
	Consolidation of activities into fewer buildings, particularly during evenings and weekends
	Development of energy efficient space allocation practices
	Scheduling of institutional vacations during energy intensive periods
	Restrictive policy on appliance usage
	Restrictive policy on air conditioning installation
	Reduction of domestic hot water temperature
	Manual reduction of fresh air makeup
	Manual monitoring of buildings
	Work schedule adjustments to maximize daylight working hours
	Reduction of building heat leakage by using blinds and drapes
	Maintenance control of existing energy systems:
	Inspection and regularized maintenance of steam traps
	Inspection and correction of valve functions and air filtration systems where needed
	ORSAT analysis of flue gasses
	Total involvement of institutional community:
	Faculty, staff and student energy committee
	Appointment of building energy monitors
	Energy briefing sessions with building occupants
	Campus-wide energy awareness programs
	Water conservation:
	Reset automatic flush valves
	Fix minor water leaks

B. REFIT	1 = Not done, not applicable 2 = Not done, would like to do 3 = Partially completed, not practical to do more	4 = Partially completed, would like to do more 5 = Completed
	Energy Analysis Program	
	Categorization of campus for energy cost and consumption analysis, by functional classification of facilities, e.g., labs, dorms, academic/athletic buildings	
	Review of existing mechanical systems & controls to identify capital investment options	
	Infra-red photographic survey to identify heat loss	
	Analysis of electrical rate structures, power factors, load profiles & demand peaks	
	Modification of lighting systems:	
	Conversion from incandescent to fluorescent, mercury vapor, quartz, sodium and other more efficient light fixtures	
	Utilization of time clocks on lighting systems	
	Revision of light switch circuitry to reduce overlighting	
	Use of task vs. area lighting	
	Modification of heating and air conditioning system towers:	
	Improve steam line insulation	
	Roof and wall insulation	
	Weatherstripping, storm windows, caulking, sun screens, blinds	
	Changes in heating/cooling systems:	
	Rezoning of heating/cooling systems	
	Installation of timers on exhaust and air handling systems	
	Installation of variable speed drives	
	Installation of motorized steam valves	
	Automated reduction of fresh air makeup	
	Centralized monitoring of buildings	
	Plumbing modifications:	
	Installation of solenoid valves on water cooled equipment	
	Installation of watersaving shower heads or flow restrictors	

C. SYSTEMS CONVERT.	1 = Not done, not applicable 2 = Not done, would like to do 3 = Partially completed, not practical to do more	4 = Partially completed, would like to do more 5 = Completed
	Installation of computerized building monitoring systems	
	Installation of central computerized controls	
	Conversion of heating systems:	
	Solar energy systems	
	Independently zoned environment controls for labs and other specialized space	
	Rewiring major electrical systems to minimize demand charges and to avoid establishing new peaks	
	Conversion from dual duct to variable volume air systems	
	Replacement or alteration of reheat systems	
	Conversion of boiler, steam and chiller plants:	
	Conversion to alternate fuel sources	
	Automation of power plants	
	Utilization of solid waste recovery fuel systems	
	Installation of waste heat recovery systems in boiler and chilled water plants	

III. *Please respond to the following questions by checking the appropriate box.*

Yes	No		
☐	☐	1.	Has an official administrative policy statement been issued by your institution on the need to conserve energy?
☐	☐	2.	Does your institution have the capacity to burn a variety of fuels?
☐	☐	3a.	Has your institution experienced difficulty in obtaining adequate fuel supplies?
☐	☐	b.	Is it now experiencing difficulty?
☐	☐	4.	Have federal allocation policies for fuels during short supply periods been examined to determine the effect of such policies on your institution?
☐	☐	5a.	Does your institution hold an interruptible contract with a gas supplier?
☐	☐	b.	If "yes", did you experience significant curtailment of gas during 1974-75?
☐	☐	c.	Do you expect (further) significant curtailment during 1975-76?
☐	☐	6.	As a result of federal, state or local environmental standards, has your institution not been allowed to burn specific types of fuel?

We realize that this survey form may not reflect certain significant aspects of energy conservation programs or problems at every institution. Please use the space below to comment about circumstances and efforts which may supplement our understanding of your institution's "energy" situation.

Thank you for your assistance.
Please return this survey by March 1, 1976, to:

HIGHER EDUCATION PANEL
AMERICAN COUNCIL ON EDUCATION
ONE DUPONT CIRCLE, N.W.
WASHINGTON, D.C. 20036

Any questions? Call (collect) (202) 833-4757

PLEASE RETAIN A COPY OF THIS SURVEY FOR YOUR RECORDS

Person Completing Form_____

Office_____

Phone_____

Appendix C: Methodology

Established by the American Council on Education in 1971, the Higher Education Panel (HEP) is a continuing research program that conducts quick-response surveys on topics of current policy interest to the higher education community and government agencies. The topic of energy costs and conservation measures at the nation's colleges and universities is obviously of timely interest, particularly since the Oil Embargo of 1973-74.

HEP Survey #31 was initially mailed out in February 1976. All institutions that had not responded by the requested return date of March 1 were followed up by telephone, and second copies of the survey package were mailed to institutions requesting them. As of June 15, the cutoff date for questionnaire returns, usable data had been received from 536 of the 637 institutions surveyed, for a response rate of 84.1 percent.

In addition to the customary item-by-item check to ensure that no key-punching errors had been made, numerous tests were conducted to examine the reasonableness of the data reported. The per-unit price of each fuel type reported by each institution for the 1972-73 and 1974-75 academic years was compared with the possible extremes in actual price range for that particular year, as shown in Table C-1.

Table C-1: Acceptable Ranges of Fuel Costs

Fuel	1972-73	1974-75
Oil, all grades (per barrel)	$2.00 -$10.00	$ 9.00 -$17.00
Natural gas (per 1000 cubic feet)	0.20 - 3.00	0.20 - 4.00
Coal (per ton)	7.00 - 24.00	15.00 - 80.00
Purchased electricity (per kilowatt hour)	0.005- 0.04	0.006- 0.05
Purchased steam (per 1000 pounds)	0.001- 0.005	0.002- 0.008
Propane (per barrel)	4.00 - 12.00	10.00 - 18.00

Reported prices that were well outside these acceptable ranges were checked by HEP staff for any discernible errors. Less obvious difficulties were resolved by discussion with officials at the responding institutions.

In addition, the amount of energy consumed per square foot was calculated to ensure that figures were comparable for the two years studied and for similar types of institutions.

Energy Conversion Factors

Factors used to convert the reported fuel consumption into a common base (BTU's) are shown in Table C-2.

Table C-2: Energy Conservation Factors

Fuel	BTU
#6 Oil (per barrel)	as reported on questionnaire; otherwise 6,451,200
#5 Oil (per barrel)	6,232,800
#4 Oil (per barrel)	6,111,000
#2 Oil (per barrel)	5,838,000
Natural gas (per 1000 cubic feet)	1,000,000
Coal (per ton)	as reported on questionnaire; otherwise 26,000,000
Purchased electricity (per kilowatt hour)	3,413
Purchased steam (per 1000 pounds	1,000,000
Propane (per barrel)	4,000,000

Weighting

The data reported by 536 respondents were statistically adjusted to represent the population of 2,987 colleges and universities in the contiguous continental United States. Because of the subject matter covered, the Panel's normal weighting procedure—based upon the institution's type, control, and enrollment size—was considered insufficient; therefore a special stratification design and weighting procedure were devised for this survey. Four variables were used: region, climate, level of energy use, and enrollment size.

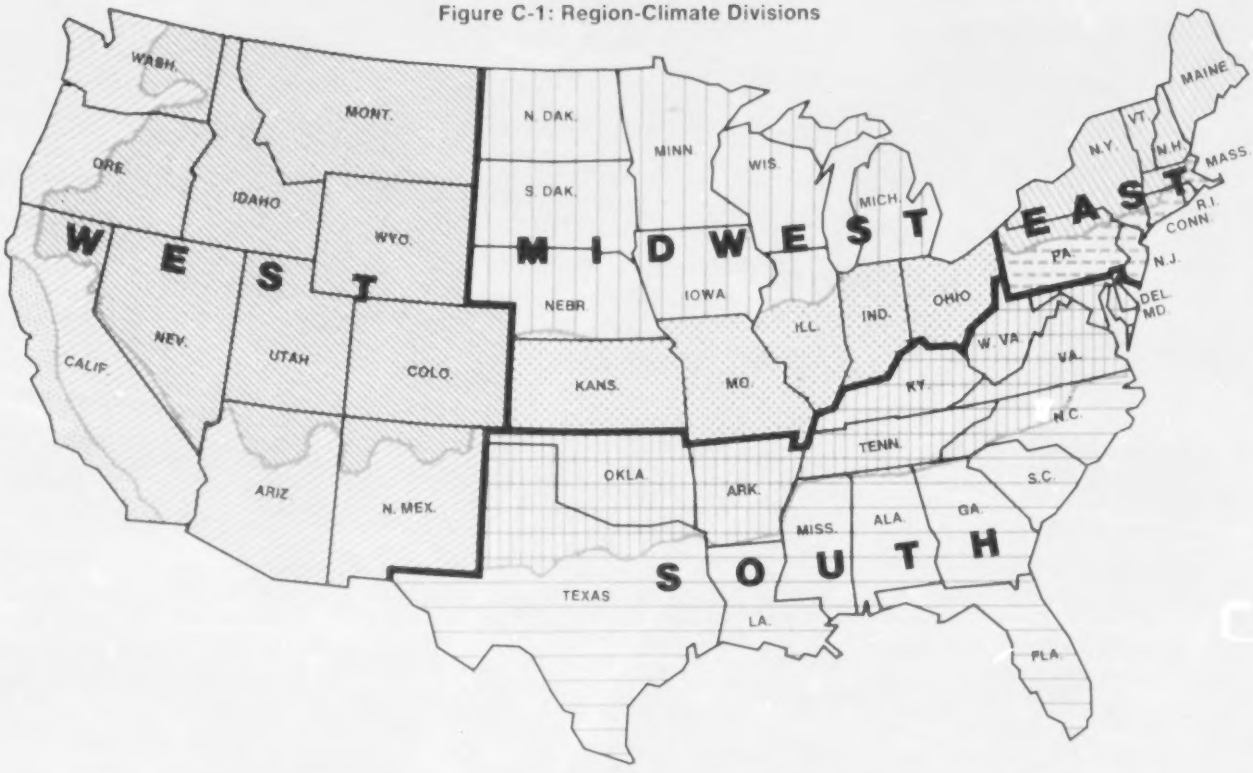
This stratification design initially consisted of the four main census regions (East, South, Midwest, West) divided into two or three "climate bands" per region, for a total of nine region-climate categories (See Figure C-1). These "climate bands" within regions were defined by the sum of the thirty-year averages of heating and cooling degree-days, as reported by the nearly 300 primary weather stations around the country.[1] Each institution was linked to the weather station located closest to it by matching the first three digits of their zip codes, but because only a small proportion (about one-third) could be successfully matched in this way, the remaining institutions were matched individually by examining state zip code maps. Thus, a particular climate value was assigned to each institution.

The third variable added to the stratification design was an approximation of energy use, which preliminary analyses of energy consumption, cost per square foot, and cost per full-time equivalent student had shown to vary with type of institution. Accordingly, the Carnegie Commission classifications were collapsed into three categories: (1) research and doctoral-granting universities and comprehensive universities and colleges (including medical schools), (2) liberal arts and all other four-year colleges, and (3) two-year colleges and institutes.

The fourth variable taken into account in the weighting process was institutional size, as measured by full-time

[1] U.S. Department of Commerce, Environmental Data Service, National Oceanic and Atmospheric Administration, "Monthly Normals of Temperature, Precipitation, and Heating and Cooling Degree Days 1941-1970," in *Climatography of the United States* (Asheville, N.C.: U.S. Government Printing Office), 1973.

Figure C-1: Region-Climate Divisions



equivalent (FTE) enrollment, which preliminary analyses showed to be highly correlated with energy consumption (.84). Square footage had also been considered for possible use as the size variable, but because figures were not readily available for both years for the entire population, it was decided to use only FTE enrollment as the control variable for size.

Since a stratification design incorporating all these factors at once would result in an excessive number of cells, Joseph Steinberg, HEP's statistical consultant, recommended a two-stage process to weight the responses of the 536 institutions up to national estimates.

STAGE I. In the first stage, each institution was assigned to its appropriate enrollment category within its Carnegie-coded group (see Table C-3). The Stage I weight for each of the 12 cells was derived by dividing the aggregate FTE enrollment of all population institutions *in one cell* by the aggregate FTE enrollment of all responding institutions in that same cell, as follows:

$$W_{h(k)} = \frac{\sum_{i=1}^{N_h} FTE_{h(i)(k)}}{\sum_{i=1}^{n_h} fte_{h(i)(k)}}$$

Where $h = 1, 2, \ldots, 12$ Stage I strata

$W_{h(k)}$ = Stage I weight for each responding institution in stratum h

$FTE_{h(i)(k)}$ = total full-time equivalent enrollment in population institution i of stratum h

$fte_{h(i)(k)}$ = total full-time equivalent enrollment in responding institution i of stratum h

N_h = number of population institutions in stratum h

n_h = number of responding institutions in stratum h

$(k) = 1, 2, \ldots, 27$ Stage II strata

The resulting 12 cell weights were then assigned to the institutions within their appropriate cells.

STAGE II. In Stage II (See Table C-4), weighting factors for each of 27 cells were calculated by dividing the aggregate FTE enrollment of all population institutions contained *in one cell* (of the Stage II strata) by the sum of the weighted total FTE enrollment of responding institutions contained *in that same cell* (of the Stage II strata), as follows:

$$f_{k(h)} = \frac{\sum_{i=1}^{N_k} FTE_{k(i)(h)}}{\sum_{i=1}^{n_k} W_{h(i)(k)}\, fte_{k(i)(h)}}$$

Table C-3: Stage I Stratification Design for Weighting: Carnegie Classification by Full-Time Equivalent Enrollment (1974-75)

Cell No.	Category	Number		Total Enrollment		
		Population	Respondents	Population	Respondents	Weight
	Doctoral and comprehensive institutions					
1	<5,000	67	22	112,604	59,250	1.900
2	5,000-9,999	55	49	419,833	377,075	1.113
3	10,000-17,999	53	46	761,292	650,233	1.171
4	18,000-45,095	45	42	1,136,880	1,054,368	1.078
	Other four-year colleges					
5	<600	546	37	159,938	16,683	9.587
6	600-999	296	55	227,810	42,438	5.368
7	1,000-2,499	429	136	693,292	215,445	3.172
8	2,500-25,480	348	77	1,985,600	514,931	3.856
	Two-year colleges					
9	<600	377	16	126,126	6,045	20.865
10	600-1,499	352	21	343,027	26,673	14.533
11	1,500-3,999	248	16	594,746	39,461	15.076
12	4,000-13,278	155	20	1,052,760	128,770	8.176
	Total	2,987	536	7,604,068	3,135,395	2.433

Table C-4: Stage II Stratification Design for Weighting: Carnegie Classification by Census and Weather Region

Cell No.	Census Region	Climate Band	Population (N=2987)	Respondents (N=536)
	Doctoral and comprehensive institutions			
1	East	1	17	12
2		2	45	31
3	Midwest	3	29	17
4		4	26	19
5	South	5	32	24
6		6	34	26
7	West	7	34	12
8		8	32	10
9		9	11	7
	Other four-year colleges			
10	East	1	146	41
11		2	337	53
12	Midwest	3	263	56
13		4	201	41
14	South	5	243	50
15		6	339	36
16	West	7	50	9
17		8	56	8
18		9	110	12
	Two-year colleges			
19	East	1	61	7
20		2	157	6
21	Midwest	3	162	8
22		4	130	9
23	South	5	154	9
24		6	226	18
25	West	7	51	1
26		8	97	8
27		9	70	5

Where $k = 1, 2, \ldots, 27$ Stage II strata

$f_{k(h)}$ = Stage II weighting factor for each responding institution in stratum k

$FTE_{k(h)}$ = total full-time equivalent enrollment in population institution i of stratum k

$fte_{k(h)}$ = total full-time equivalent enrollment in responding institution i of stratum k

$W_{h(k)}$ = weight for institution i of Stage I stratum h

N_k = number of population institutions in stratum k

n_k = number of responding institutions in stratum k

The resulting 27 Stage II weighting factors were then multiplied by the appropriate Stage I basic weights for each of the institutions within their respective cells. The final weight for each institution was the product of its Stage I basic weight and Stage II weighting factor, as follows:

$$W'_{i(h)(k)} = W_{h(k)} \; f_{k(h)}$$

Where $W'_{i(h)(k)}$ = final weight for responding institution i in Stage I stratum h and Stage II stratum k

Appendix D: Comparison of Respondents and Nonrespondents

The survey instrument was mailed to all Panel member institutions in the contiguous 48 states and the District of Columbia. Colleges and universities located in Hawaii and Alaska and on islands in the Pacific and Caribbean were excluded from the survey because of their unique climates and energy needs.

Of the 637 eligible Panel members, usable responses were received from 536 institutions (84 percent) before the deadline for returning questionnaires. Table D-1 compares respondents with nonrespondents and the Panel membership with the population in terms of institutional type, control, location, and student enrollment.

Different kinds of institutions differed sharply in their tendency to respond to the survey. Clearly, larger institutions, usually universities, are better able to collect and retrieve data on energy than are many small colleges. Notably underrepresented were two-year colleges (74 percent response rate), particularly private two-year colleges (58 percent), and institutions with fewer than 1,000 students (70 percent). Higher-than-average response rates were recorded for both public and private universities (96 percent and 93 percent, respectively), and for institutions enrolling more than 7,000 students (97 percent).

The Higher Education Panel is a disproportionate stratified sample and thus is not, by itself, a direct sample representation of the institutional population. For example, the Panel, as compared with the entire population, includes:

- A larger proportion of universities (22 percent vs. 5 percent)
- A larger proportion of institutions enrolling 7,000 or more students (25 percent vs. 9 percent)
- A smaller proportion of public two-year colleges (10 percent vs. 30 percent)
- A smaller proportion of institutions enrolling fewer than 1,000 students (27 percent vs. 50 percent)

These imbalances are corrected within each cell of the stratification design by the procedures used to weight the survey data to national estimates (see Appendix C).

Table D-1: Comparison of Respondents and Nonrespondents

Characteristic	Population[a] (N=2707)	Panel[a] (N=637)	Respondents (N=536)	Nonrespondents (N=101)	Panel Response Rate
Total	100.0	100.0	100.0	100.0	84.1
Control					
Public	47.6	40.0	42.7	25.7	89.8
Private	52.4	60.0	57.3	74.3	80.4
Carnegie classification					
Doctoral and comprehensive	7.4	26.8	23.5	12.9	92.4
Other four-year	58.1	57.6	56.9	61.4	83.1
Two-year	37.6	15.5	13.6	25.7	73.7[b]
Full type					
Public two-year	29.8	9.8	9.3	18.8	82.5
Private two-year	8.1	5.7	3.9	14.9	58.3[b]
Public four-year	15.1	16.8	17.5	12.9	87.9
Private four-year	41.6	45.2	43.9	54.5	80.9
Public universities	3.1	13.5	15.8	1.0	96.8[c]
Private universities	2.8	9.8	9.8	4.0	93.9[c]
Census region					
East	26.1	25.4	27.8	26.7	84.7
Midwest	27.3	28.0	29.0	31.7	82.4
South	31.2	29.8	30.4	25.7	86.2
West	15.4	16.1	13.0	15.8	82.2
Total enrollment (1983-84)					
45,000	49.6	26.8	22.4	59.5	70.2[b]
1,000-2,499	12.5	17.1	15.7	11.9	87.5
1,000-6,999	28.9	14.8	33.5	32.7	94.4
7,000 or more	9.4	25.0	28.5	5.9	96.9[c]

[a] Includes only the contiguous 48 states and the District of Columbia.

[b] Response rate falls short of the overall response rate by more than 10 percent.

[c] Response rate exceeds the overall response rate by more than 10 percent.

Other Reports of the Higher Education Panel
American Council on Education

Blandford, B. and Dutton, D. **Survey of First-Year Graduate and Postdoctoral Enrollment in Science and Engineering.** Higher Education Panel Report, No. 1, August, 1971.

Blandford, B. and Dutton, D. **Research Support for Science Faculty.** Higher Education Panel Report, No. 2, November, 1971.

Astin, A., Blandford, B., and Mahn, T. **Freshman Class Vacancies in Fall 1971 and Recent Trends in Enrollment of Minority Freshmen.** Higher Education Panel Report, No. 3, February, 1972.

Changes in Graduate Programs in Science and Engineering 1970-72 and 1972-74. Science Resources Studies Highlights. Washington: National Science Foundation, July, 1972.

Blandford, B. and Sell, C. **Enrollment of Junior-Year Students (1970 and 1971).** Higher Education Panel Report, No. 5, April, 1972.

Trexler, J. and Blandford, B. **What College Presidents Are Reading.** Higher Education Panel Report, No. 6, March, 1972.

Trexler, J. and Kent, L. **Commercial Theme-Writing Services.** Higher Education Panel Report, No. 7, June, 1972.

Furniss, W. T. **Faculty Tenure and Contract Systems: Current Practice.** ACE Special Report, July, 1972.

Bayer, A. E. and Astin, A. W. **War Protest on U. S. Campuses During April 1972.** Higher Education Panel Report, No. 9, May, 1972.

Blandford, B. A. and Trexler, J. C. **Expected First-Year Graduate Enrollment in Science and Engineering, Fall 1972.** Higher Education Panel Report, No. 10, August, 1972.

Blandford, B. A. **Student Participation on Institutional Governing Boards.** Higher Education Panel Report, No. 11, October, 1972.

Dutton, J. E. and Blandford, B. A. **Enrollment of Junior-Year Students (1971 and 1972).** Higher Education Panel Report, No. 12, April, 1973.

Dutton, J. E. **Courses and Enrollment in Ethnic/Racial Studies.** Higher Education Panel Report, No. 14, August, 1973.

Dutton, J. E. and Jenkins, M. D. **The Urban Involvement of Colleges and Universities.** Higher Education Panel Report, No. 15, August, 1973.

Dutton, J. E. and El-Khawas, E. H. **Production of Doctorates in Selected Fields, 1972-1975.** Higher Education Panel Report, No. 16, April, 1974.

Dutton, J. E. **First-Year Enrollment for Masters or Higher Degrees, Fall 1973.** Higher Education Panel Report, No. 17, April, 1974.

El-Khawas, E. H. and Kinzer, J. L. **The Impact of Office of Education Student Assistance Programs, Fall 1973.** Higher Education Panel Report, No. 18, April, 1974.

El-Khawas, E. H. and Kinzer, J. L. **Enrollment of Minority Graduate Students at Ph.D. Granting Institutions.** Higher Education Panel Report, No. 19, August, 1974.

El-Khawas, E. H. **College and University Facilities: Expectations of Space and Maintenance Needs for Fall 1974.** Higher Education Panel Report, No. 20, September, 1974.

Kinzer, J. L. and El-Khawas, E. H. **Compensation Practices for Graduate Research Assistants: A Survey of Selected Doctoral Institutions.** Higher Education Panel Report, No. 21, October, 1974.

El-Khawas, E. H. and Furniss, W. T. **Faculty Tenure and Contract Systems: 1972 and 1974.** Higher Education Panel Report, No. 22, December, 1974.

El-Khawas, E. H. and Kinzer, J. L. **A Survey of Continuing Education Opportunities Available to Nonacademic Scientists, Engineers and Mathematicians.** Higher Education Panel Report, No. 23, April, 1975.

Atelsek, Frank J. and Gomberg, Irene L. **Bachelor's Degrees Awarded to Minority Students, 1973-74.** Higher Education Panel Report, No. 24, January, 1977.

Atelsek, Frank J. and Gomberg, Irene L. **Nonfederal Funding of Biomedical Research and Development: A Survey of Doctoral Institutions.** Higher Education Panel Report, No. 25, July, 1975.

Gomberg, Irene L. and Atelsek, Frank J. **Major Field Enrollment of Junior-Year Students, 1973 and 1974.** Higher Education Panel Report, No. 26, April, 1976.

Atelsek, Frank J. and Gomberg, Irene L. **Student Assistance: Participants and Programs, 1974-75.** Higher Education Panel Report, No. 27, July, 1975.

Atelsek, Frank J. and Gomberg, Irene L. **Health Research Facilities: A Survey of Doctorate-Granting Institutions.** Higher Education Panel Report, No. 28, February, 1976.

Atelsek, Frank J. and Gomberg, Irene L. **Faculty Research: Level of Activity and Choice of Area.** Higher Education Panel Report, No. 29, January, 1976.

Atelsek, Frank J. and Gomberg, Irene L. **Young Doctorate Faculty in Selected Science and Engineering Departments, 1975 to 1980.** Higher Education Panel Report, No. 30, August, 1976.

Atelsek, Frank J. and Gomberg, Irene L. **Foreign Area Research Support Within Organized Research Centers at Selected Universities, FY 1972 and 1976.** Higher Education Panel Report, No. 32, December, 1976.

Atelsek, Frank J. and Gomberg, Irene L. **College and University Services for Older Adults.** Higher Education Panel Report, No. 33, February, 1977.

Single copies of the above reports may be obtained from the Higher Education Panel, American Council on Education, One Dupont Circle, Washington, D. C. 20036.